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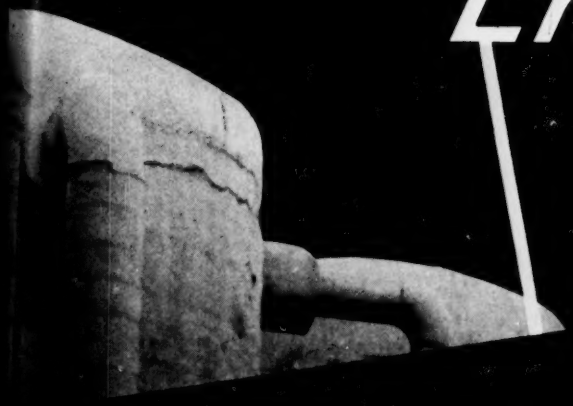
Chemical Engineering

A McGRAW-HILL PUBLICATION



NEW DEVELOPMENTS ENHANCE THE ROLE OF

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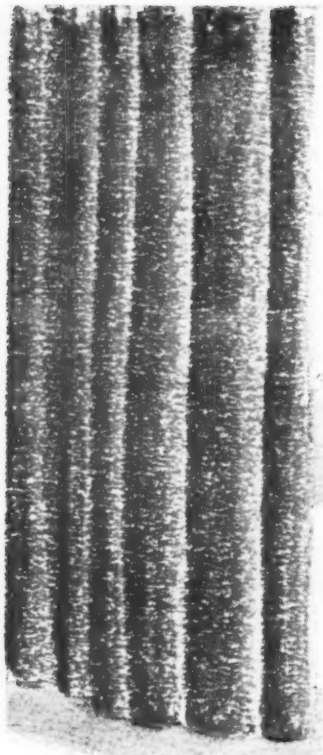
a CE report page 105



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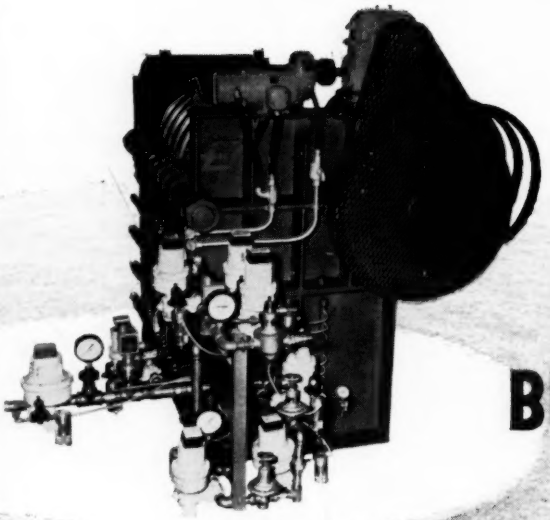

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Another Eimco achievement in the development of equipment for liquid-solids separation is the Eimco-Burwell filter shown above. Built for a separation process involving the recovery of a valuable metal, this is the first plate and frame filter capable of completely automatic operation.

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The automated Eimco-Burwell represents the end result of thousands of hours of development work by Eimco engineers. It represents, too, the elimination of high labor costs commonly associated with the operation of plate and frame filter presses.

The Eimco-Burwell is unequalled by any filter for washing out the highest percentages of soluble values from the cake, or for producing a filtrate containing an absolute minimum of contaminants. It can handle materials of widely varying characteristics, including viscous slurries.

For more details, get in touch with the Eimco representative in your area. Or, write the Eimco Filter Division for Bulletin F - 2052.

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B.F.Goodrich

Photo courtesy Arnold Hoffman & Co., Inc., Providence, R.I.

Filling station for fire water

B. F. Goodrich improvements in rubber brought extra savings

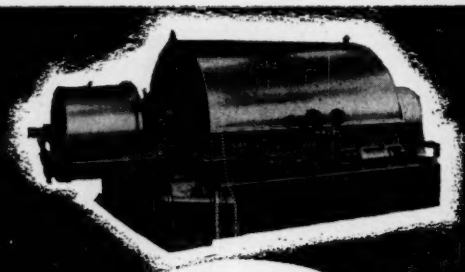
Problem: In making dyes and finishes for fine fabrics, they use hot, corrosive acid by the tankload. It's pumped from truck to storage tank through hose. But the acid is so strong and powerful, it would eat its way through regular rubber hose. Metal tubing couldn't take the sharp angles or stand much bending. Acid leaks were costly, dangerous to workers.

What was done: After talking with a B.F.Goodrich man, the company decided to try a new hose which had just been developed by B.F.Goodrich. The lining of this hose is made with a new rubber compound that can stand even the corrosive acids and chemicals that destroy ordinary rubber.

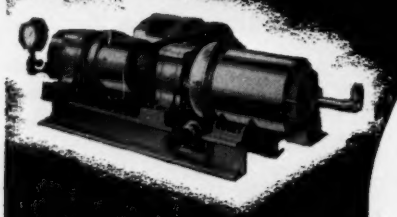
Savings: This improved B.F.Goodrich acid hose is what you see in the picture. It has already lasted a year and a half, and is good for still longer life. The B.F.Goodrich hose has put an end to the waste and danger of acid leaks, the cost of frequent hose replacements. Workmen claim the hose is lighter, easier to handle because it's so flexible, faster to hook up because of special attachments at the hose ends.

Where to buy: Your B.F.Goodrich distributor has complete information on the new B.F.Goodrich acid hose described here. And, as a factory-trained specialist in rubber products, he can answer your questions about *all* the rubber products B.F.Goodrich makes for industry. *B.F.Goodrich Industrial Products Company, Dept. M-780, Akron 18, Ohio.*

B.F.Goodrich *industrial rubber products*



Bird Continuous Solid Bowl Centrifugal, 54 in. bowl dia., delivers up to a ton or more per minute of well dewatered solids.



Bird Solid Bowl Centrifugal, 6 in. bowl dia., operates at up to 6000 rpm.

why so many different Birds?

Solid-Liquid Separating Jobs differ

in volume
in solids characteristics
in liquid characteristics
in feed consistency
in feed temperature
in wash requirements
in end result requirements

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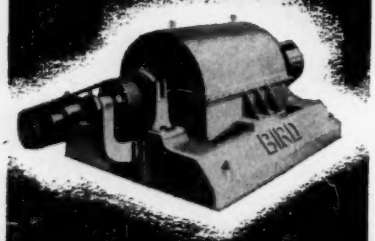
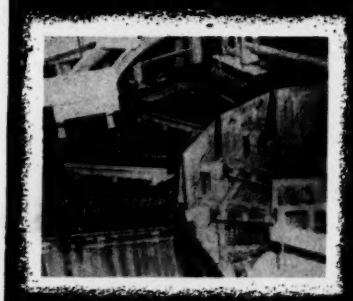
The Bird for *your* job will do it better, or faster, or cheaper — or else it won't be recommended. You can depend on that.

The Bird Research and Development Center is equipped to make pilot-scale tests of *your* feed slurries under *your* operating conditions and come up with findings that you can accept with full understanding and confidence.

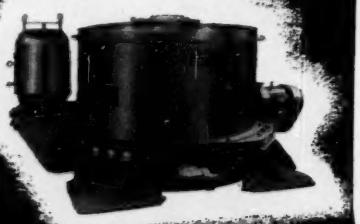
Bird-Young Rotary Vacuum Filter provides several times the usual capacity per foot of filter area. Operates totally enclosed, fume-tight when desired.



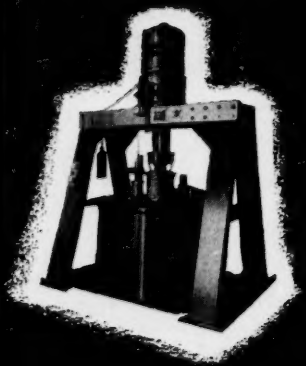
Bird Solid Bowl Centrifugal, 24" bowl dia., one of seven sizes, each subject to 25 design variations.



Bird-Prayon Horizontal, Tilting Pan, Vacuum Filter combines large capacity with super-effective, multi-stage washing.



Bird-Humboldt Oscillating Screen Centrifuge dewaters plus 65 mesh solids with almost no degradation or solids loss.



Bird Suspended Batch Centrifuge, 40" or 48" basket, perforate or imperforate.

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February 8, 1960 **Chemical Engineering** Vol. 67 No. 3

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CHEMENTATOR — Top Chemical Developments and What They Mean, 53
What's New and Significant in Research, 60

PROCESSES & TECHNOLOGY — Liquid Phase Works for Dehydrogenation, 63
Finer Feed Improves Nitrogenation, 66
No Frost in New Chemical Line, 70

CHEMICAL ECONOMICS — Chemical Men Look South of the Border, *F. B. Loretta*, 74

NEW CHEMICAL PRODUCTS — Newsworthy Chemicals & Raw Materials, 78

NEW PROCESS EQUIPMENT — New Equipment Developments, 84
Equipment Cost Index, 175

PROCESS FLOW SHEET — Making Iron in a Fluidized Bed, 96

•

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FEATURE REPORT — Fixed-Bed Absorption, *H. M. Barry*, 105

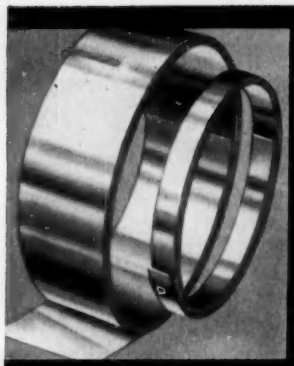
FRONT COVER: Adsorption units drying natural gas at Union Carbide Olefins, Hastings, W. Va. Each 8-ft.-dia. unit contains 25,000 lb. of adsorbent.

FEATURE ARTICLES — Systems Engineering, *Theodore J. Williams*, 121
How to House Process Development, *G. W. Schustek, Jr.*, 127
Use Capital Ratio, *L. Lynn, R. F. Howland*, 131

YOU & YOUR JOB — Demand Forces Salaries Up Again, 139*

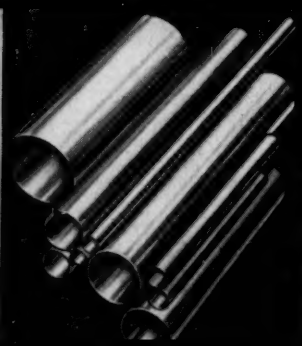
*FREE—for your files—Check Reader Service postcard (p. 183) for an extra copy of this report on where salaries are heading.

Contents Continued . . . turn page



Solid & Clad Sheet

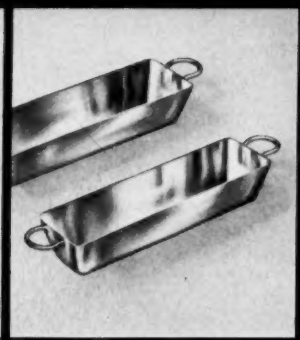
Solid & Clad Wire



Solid & Clad Tubing

Solid & Clad Laboratory Ware

Thermocouple Wire



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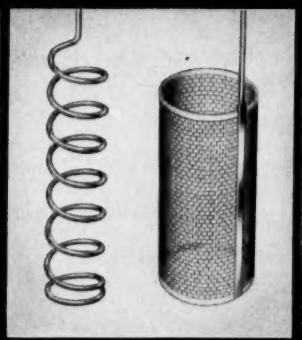
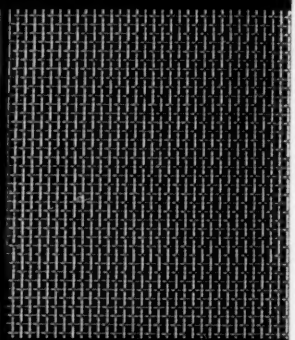


Electrodes



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Contents, Continued

Chemical Engineering

February 8, 1960

PRINT ORDER OF THIS ISSUE: 51,114

PROCESS DESIGN NOTEBOOK — Nomographs Help Find Tank Diameter, *Leon Grun*, 143
Timed Bench-Sized Screw Feeder, *Carlos A Zapata*, 144

CE COST FILE — Construction Equipment Rental Rates, *Charles A. Adams*, 146

OPERATION & MAINTENANCE — Don't Accept Specification Headaches, *W. H. Richardson*, 148

CORROSION FORUM — Higher Purity Boosts Zirconium Resistance, *W. E. Kuhn*, 154

•

OTHER REGULAR FEATURES
Firms in the News, 162
Convention Calendar, 168
More New Equipment Developments, 170
Technical Bookshelf, 177
Letters: Pro & Con. 180
Classified Section, 211
Equipment Searchlight, 212

•

READER SERVICE
Reader Servic Postcard, 183
Reprints Now Available, 185
Guide to Technical Literature, 186
Advertisers in This issue, 220

•

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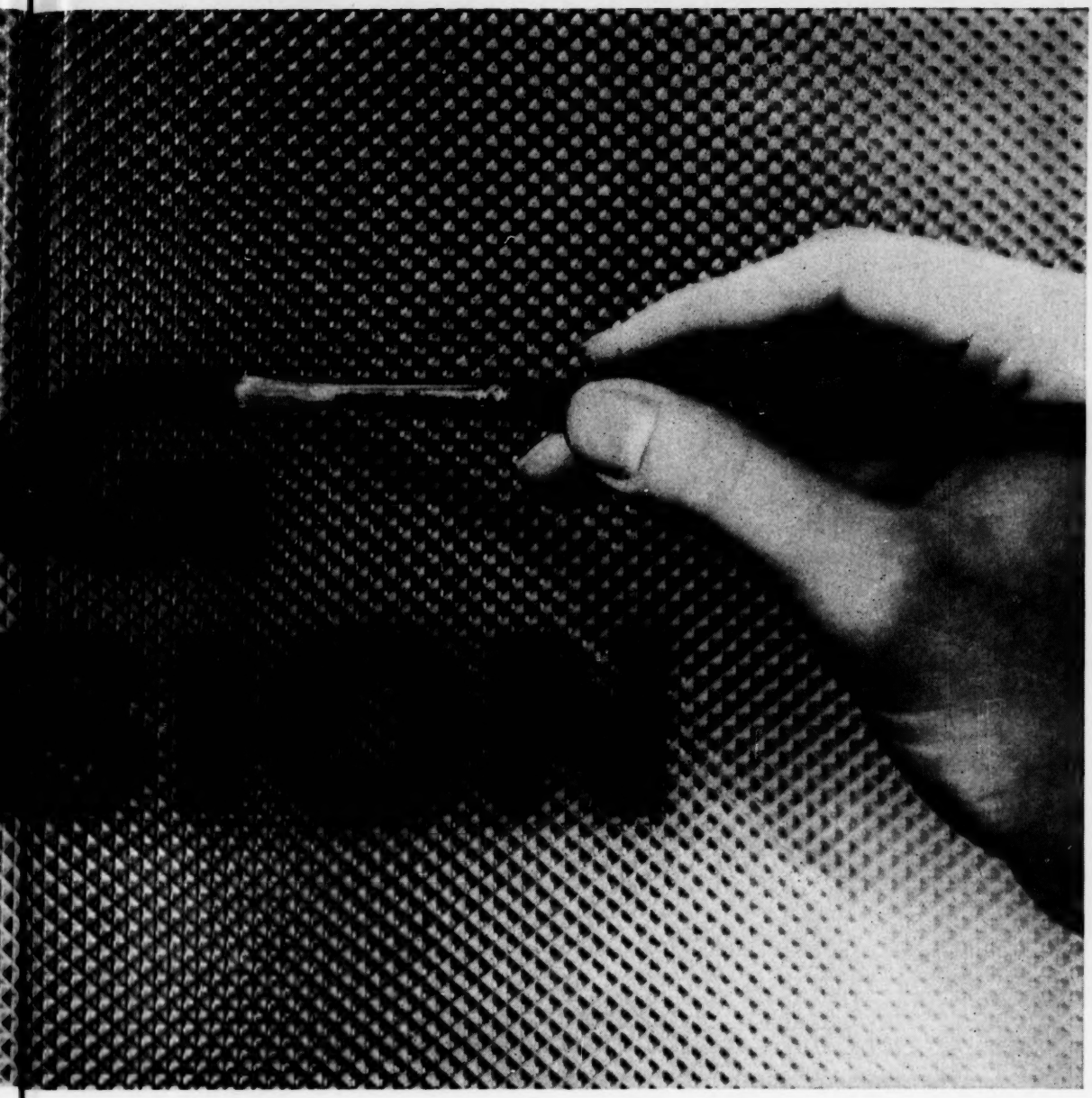

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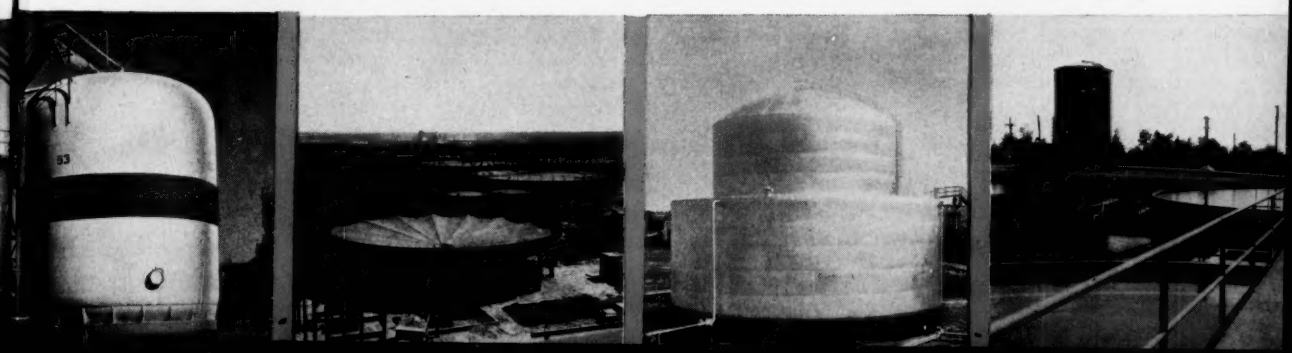
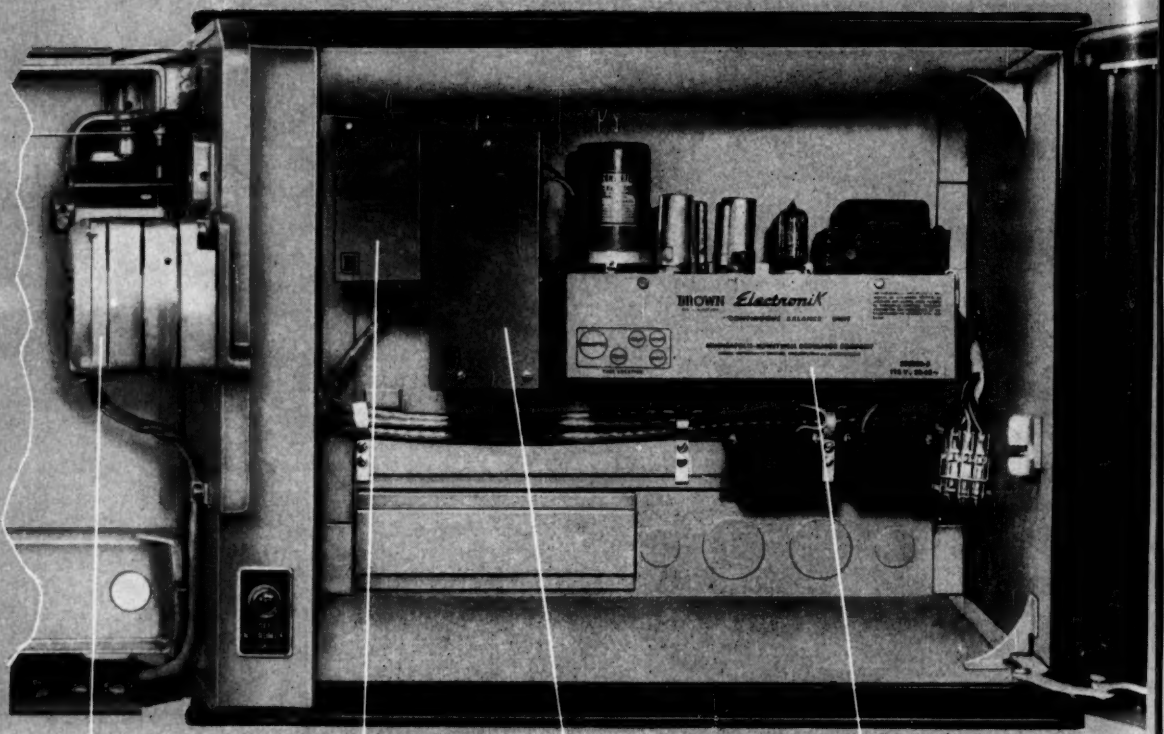
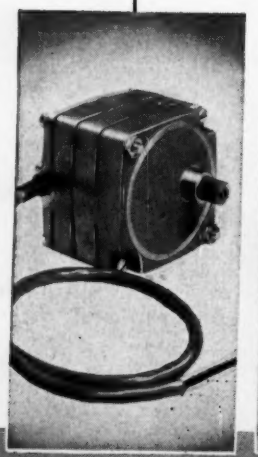
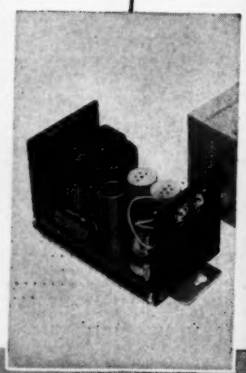


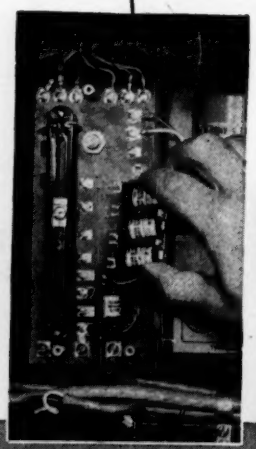




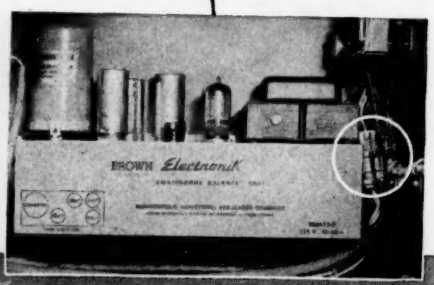
Servo Meter has sectional housing, leakproof oil wick, printed circuits for simplified servicing. Any major part can be replaced in 2 minutes.



Constant Voltage Module—Uses Zener diodes and an ambient temperature compensator to replace standardizing mechanism.



Measuring Circuit Module—Contains easily-changed range spool panels and vernier adjustment. Range is changed simply by replacing screw-clip panels of fixed resistors.



Amplifier Module—Quick-connect design permits fast, easy removal for servicing and replacement. Circle shows quick connect plug.

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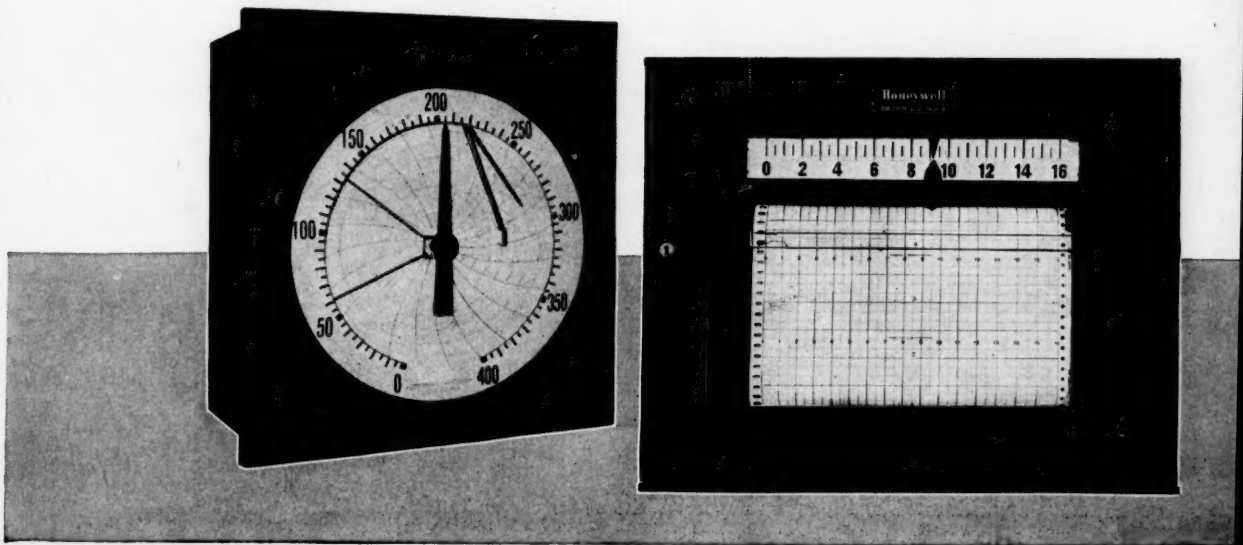
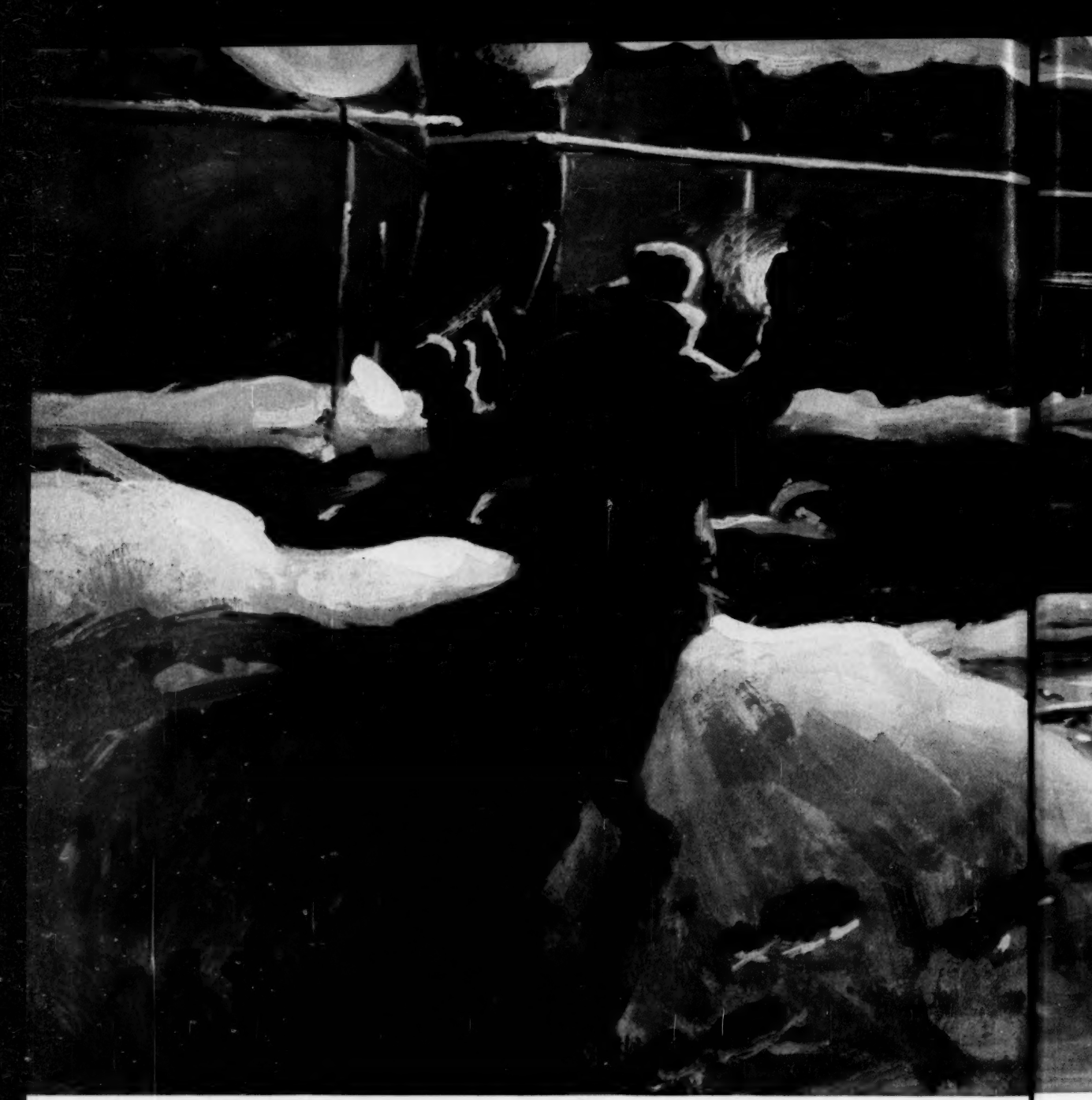
PIONEERING THE FUTURE

Honeywell

H HONEYWELL *First in Control* SINCE 1885



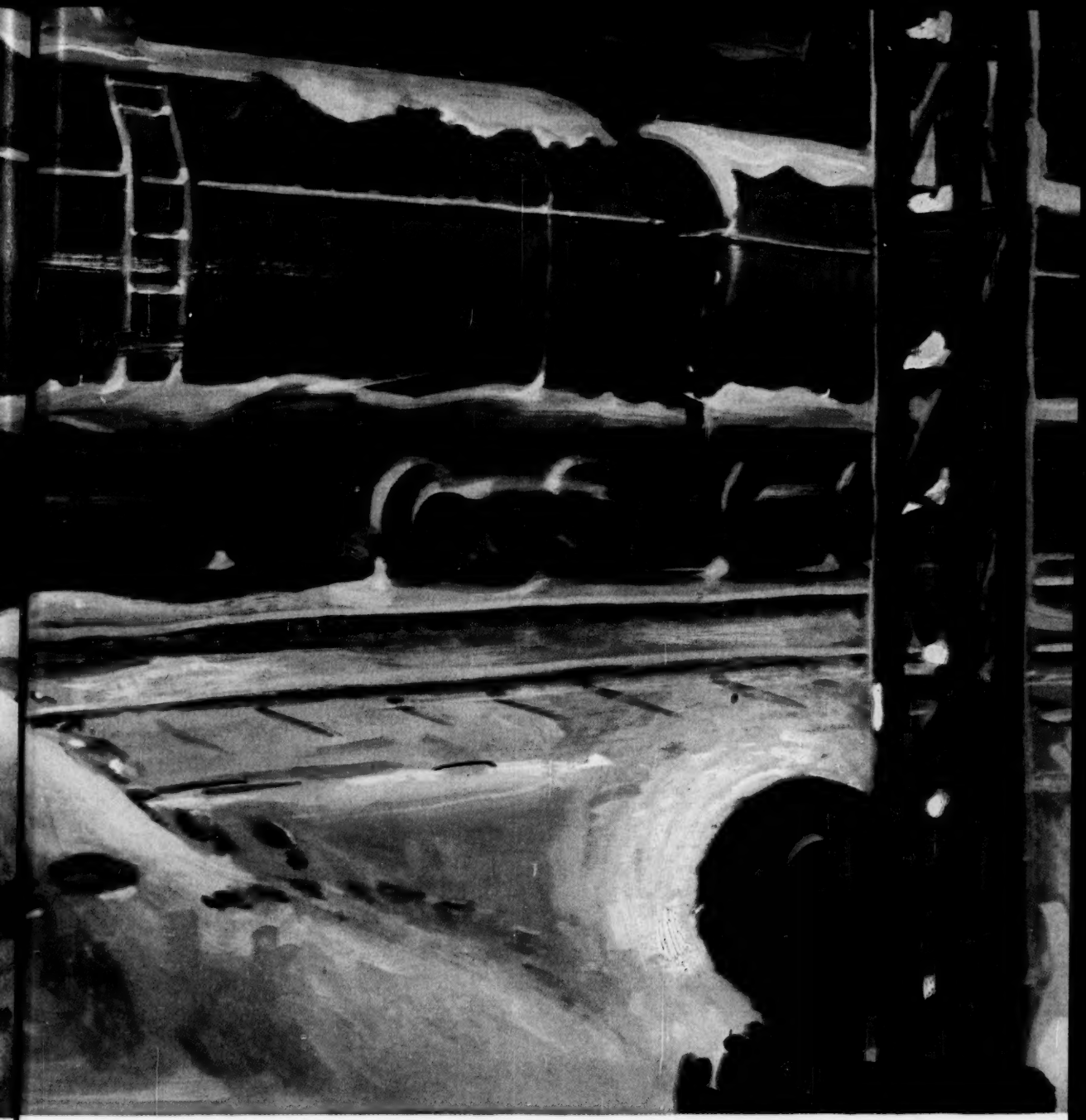


now...industry's workhorse ch

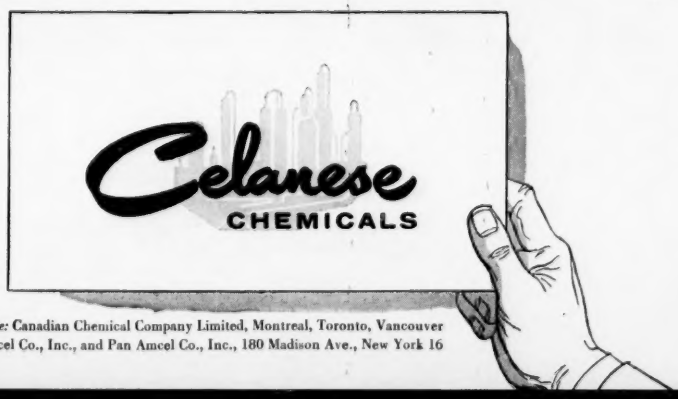
When an industrial chemical as big as formaldehyde must be kept warm in transit and storage in order to prevent its deterioration, the costs for heated storage add up to a sizeable annual expense for industry.

Now a recent development of Celanese research promises substantial reduction in this expense for formaldehyde users. The new Celanese process "builds in" low temperature stability to permit safe storage at a full 15-20 degrees F. below previously recommended levels . . . makes possible higher formaldehyde concentrations with resultant economies in processing. Users will be interested in this stabilized formaldehyde. It has been thoroughly field tested, and it costs no more. Write us for corroborating data. Celanese Chemical Company, a Division of Celanese Corporation of America, Dept. 553-B, 180 Madison Avenue, New York 16, N. Y.

Celanese®



echemical beats the cold

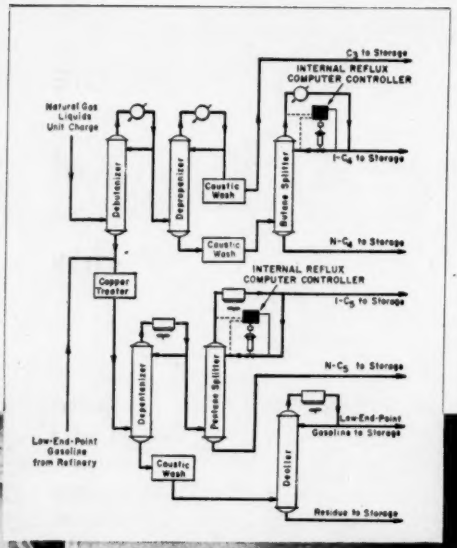


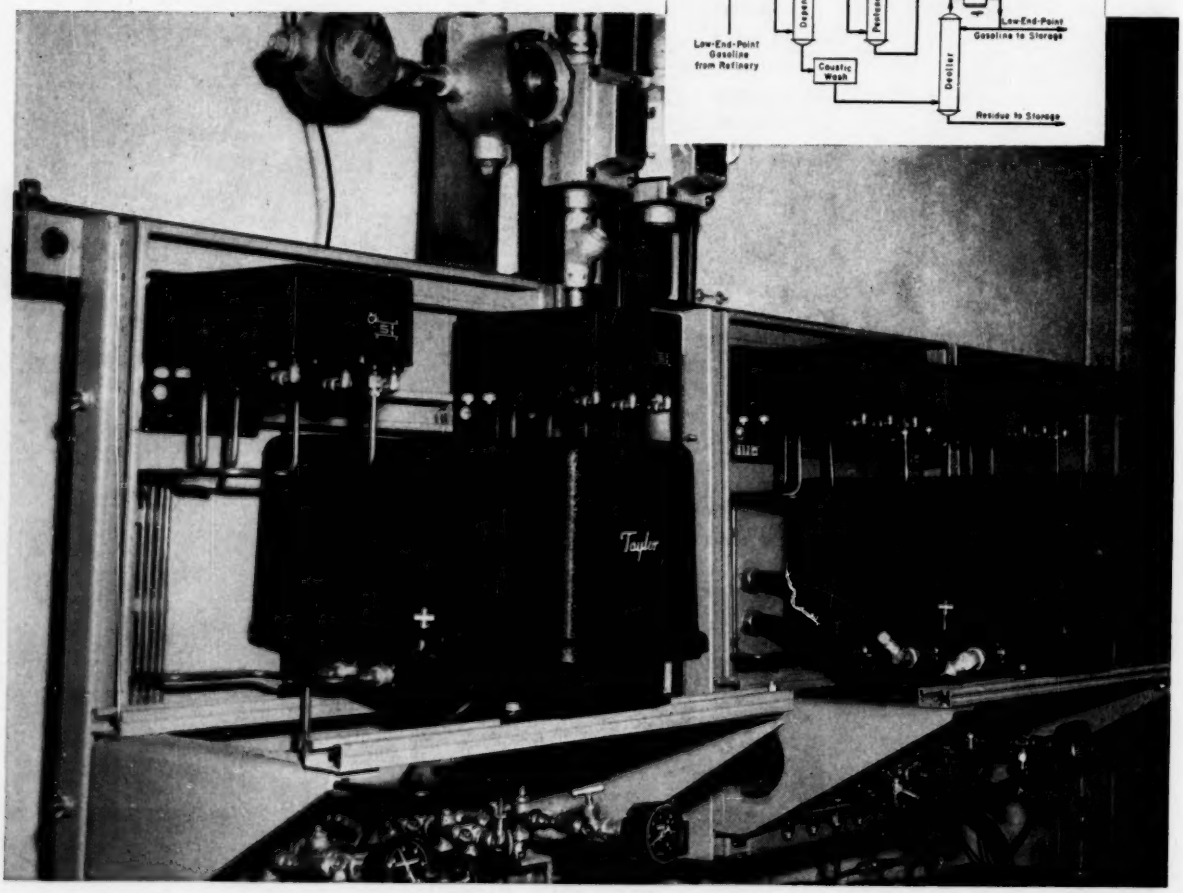
Canadian Affiliate: Canadian Chemical Company Limited, Montreal, Toronto, Vancouver
Export Sales: Amcel Co., Inc., and Pan Amcel Co., Inc., 180 Madison Ave., New York 16

MORE PROFIT PER

Drawing at right shows the Taylor Internal Reflux Computer System, installed at Phillips' Sweeny, Texas, Refinery on LP gas fractionation columns. It can be supplied with either pneumatic or electrical output. It fits into any control system already installed—also into any large scale digital or unit analytical computer installation. Set point can be adjusted manually by the operator or automatically from column temperature, process analyzers and/or computers, etc.

Components are all standard, proven units. The Taylor Potentiometer Transmitter permits the use of thermocouples in place of special resistance elements for narrow span differential temperature measurement.





Taylor Computer-Controllers in use on the light ends fractionation system, typical of several systems in use as shown in drawing above.

Taylor Instruments

BARREL OF PRODUCT...

Phillips Petroleum Co. reports optimum fractionator efficiency with Taylor Internal Reflux Computer Control

THE Taylor Internal Reflux Computer Control System consists of the addition of a simple analog computer to a fractionating column. It maintains optimum reflux flow by instantly compensating for climatic effects encountered in outdoor installations. This means:

1. Consistent product quality—no rerunning or blending.

2. Maximum utilization of existing installation.

3. Minimum consumption of steam, air and water.

4. Elimination of flooding—run to design capacity without loss of product.

5. Increased production with no process change. Adaptable to any column design and existing piping and instrumentation.

• • •

Here are Phillips Petroleum Company's answers to questions commonly asked about this system:

Are steam savings effected when using Internal Reflux Computer Controls?

"They minimize reflux adjustments necessary for day and night ambient temperature changes, thereby effecting steam savings. At the same time they contribute to the maintenance of overhead product specifications. A lower reflux ratio obviously saves steam".

Are increased product yields realized by use of computer-controls?

"While it is difficult to pin-point exact increases, we can say they permit continued tower operation at maximum load levels. Without reflux computer-controllers, column operation must be at a less efficient level to reduce hazard of flooding".

Does use of computer-controllers permit use of lower reflux-to-product ratio?

"Yes—particularly when operating to maintain product specifications, such as a minimum of 95% isopentane overhead product. Without computer-controllers it would be necessary to operate at 97% isopentane to insure a minimum 95% product".

Do computer-controllers help meet product specifications?

"Yes—they compensate and 'short-stop' transient column conditions resulting from minor temperature, pressure and feed composition changes. It is no longer necessary to have product samples analyzed in the laboratory to serve as a guide for the operator to make changes in external reflux flow rate".

Are plant operators pleased with the performance of computer-controllers?

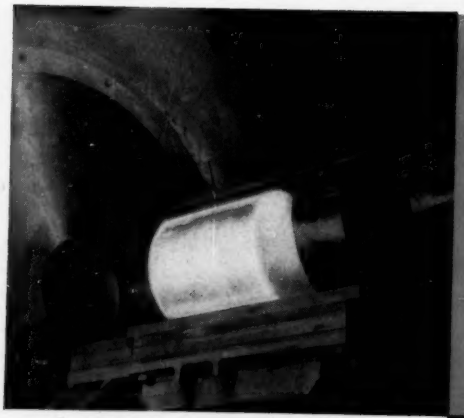
"They are well pleased with the installations. They appreciate the smoother column operation and ease of meeting product specifications."

• • •

Ask your Taylor Field Engineer for full information about this system, developed and licensed by Phillips Petroleum Company, or write Taylor Instrument Companies, Rochester, N. Y., or Toronto, Ontario.

MEAN ACCURACY FIRST

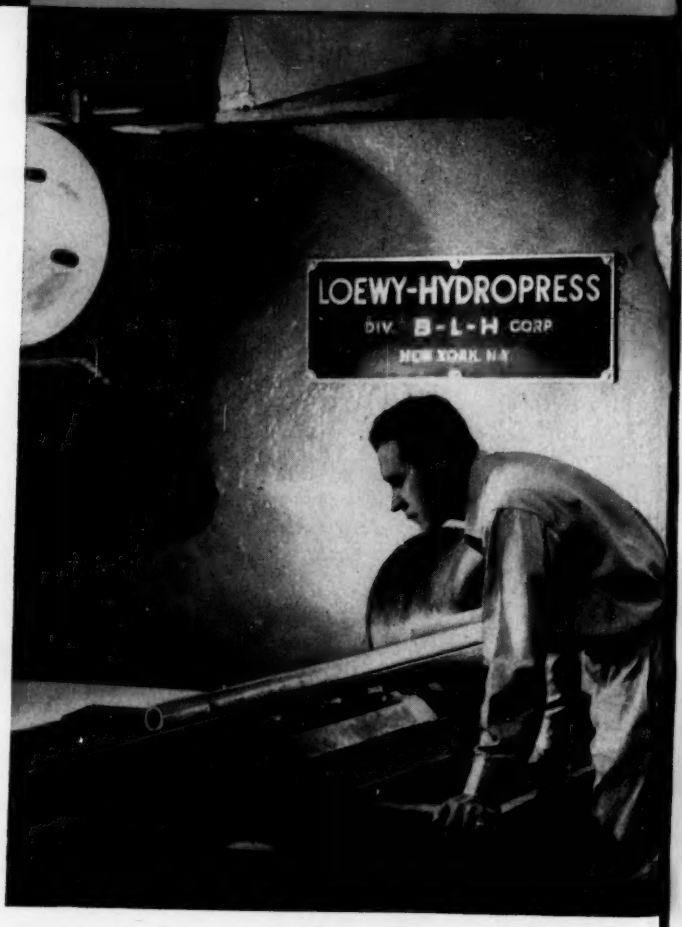
How lasting quality i
Heat Exchange



Heated billet ready for insertion into extrusion press.

2 EXTRUDING

(SECOND OF A FIVE-PART SERIES)



Billet emerges from extrusion press as a heavy-walled tube, or shell.

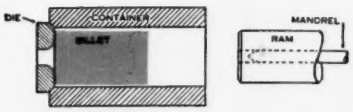
...uilt into Phelps Dodge ...end Condenser Tubes...

Phelps Dodge heat exchanger and condenser tubes are formed from billets by the hot-forged extrusion process, a method that produces sturdy, seamless tubes with long service life, finest properties and precise dimensions.

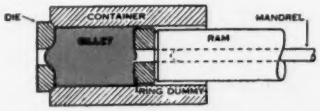
The metal billet, before being placed within the container of the extrusion press, is first heated in a controlled atmosphere to a temperature predetermined for each specific alloy. The subsequent forging (upsetting) and extruding operations are combined in a simultaneous operation.

The billet is forged by a compression system using several million pounds of hydraulic pressure. This operation refines the grain and achieves maximum densification of the billet. Finally, a highly polished steel mandrel is used to pierce the billet, thus forcing extrusion of the metal over and around the mandrel and through a steel die into the form of a heavy wall tube.

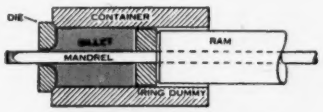
Throughout the entire tube fabricating operation—from raw materials to finished product—quality is the keynote. That's why Phelps Dodge tubes are preferred by those who demand the finest . . . the manufacturers and users of heat exchangers and condensers.



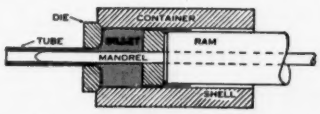
Billet is placed within container for forging operation.



Heated billet is forged within container through action of the ram pressing on the ring dummy-block.



Steel mandrel pierces billet just before extrusion takes place.



Hydraulic pressure exerted on ram and ring dummy-block causes metal to flow over mandrel and through die.

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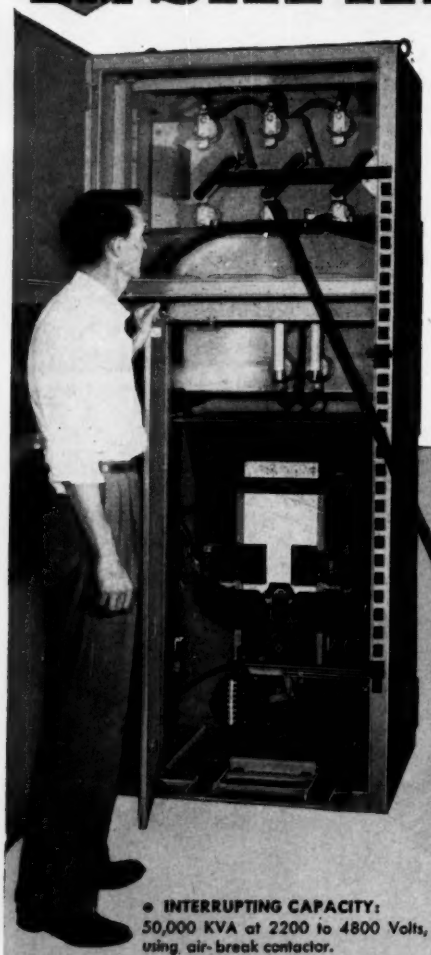
For those who think twice about their

TWO E-M MOTOR CONTROL LINES OF

E-M SAFAIR Magnetic Control (NEMA CLASS E-1)

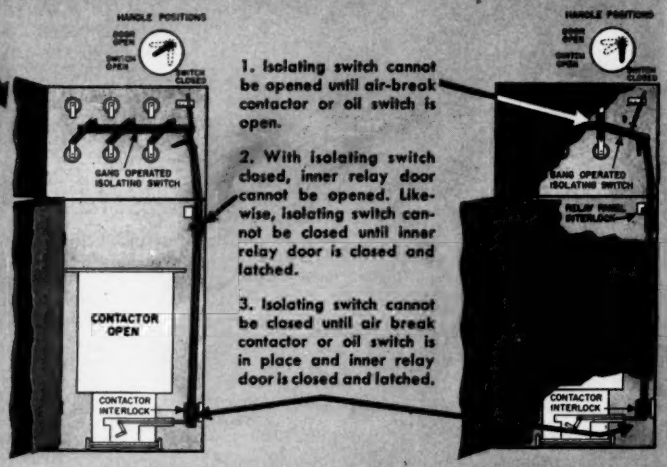


● **INTERRUPTING CAPACITY:** 50,000 KVA at 2200 to 4800 Volts, using air-break contactor.

Compare these features with those of your present controls

1. **Complete Personnel Safety** with a foolproof system of mechanical interlocking between gang-operated isolating switch, oil switch or air-break contactor, and compartment doors.
2. **Complete Motor And Control Protection.** Skillfully engineered and applied components are carefully coordinated to protect both motor and control over complete design range of overload and fault conditions.

You can't make a mistake with the E-M Mechanical Interlock!



1. Isolating switch cannot be opened until air-break contactor or oil switch is open.

2. With isolating switch closed, inner relay door cannot be opened. Likewise, isolating switch cannot be closed until inner relay door is closed and latched.

3. Isolating switch cannot be closed until air break contactor or oil switch is in place and inner relay door is closed and latched.

E-M SAFETY-GANG ISOLATING SWITCH of SAFAIR Control is externally operated, internally interlocked as detailed in color and diagrams above, right.

SAFAIR features a 50,000 kva (NEMA Class E-1 maximum rating) air-break contactor suitable for repetitive motor starting and rapid switching in a complete line of squirrel-cage and wound-rotor induction motor controls and synchronous motor controls.

PFR* for Simple, Reliable SYNCHRONOUS MOTOR CONTROL

Safair- and Safuse-controlled synchronous motors pull into step smoothly and powerfully every time. E-M-invented *Polarized Field Frequency Relay system of synchronous motor

3300-TPA-2189

ELECTRIC MACHINERY

Originators of the safety-gang

...about their men and motors...

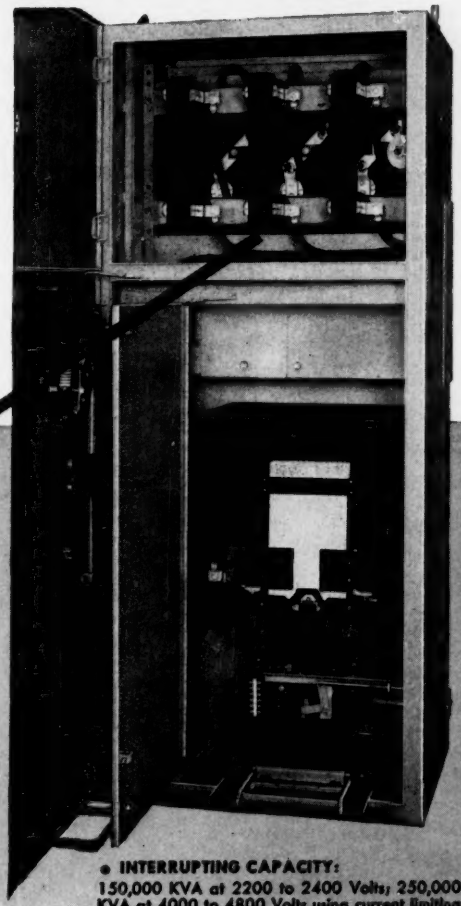
E-M OFFER COMPLETE PROTECTION!

SAFUSE Magnetic Control (NEMA CLASS E-2)

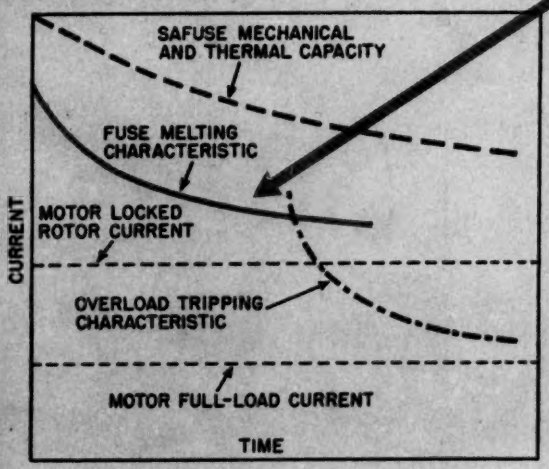
3. **Complete Front Accessibility.** Controls may be placed in rows, back-to-back or back-to-wall—no access required to back or sides.

4. **Complete Space Utilization.** Imaginative E-M engineering has provided a highly compact control design without compromise on safety or performance, and with provision to accommodate modifications.

5. **Complete Modification Line.** You can tailor the control to fit your exacting requirements—nearly 100 options and special features available.



• **INTERRUPTING CAPACITY:** 150,000 KVA at 2200 to 2400 Volts; 250,000 KVA at 4000 to 4800 Volts, using current limiting fuses with air-break contactor or oil switch.



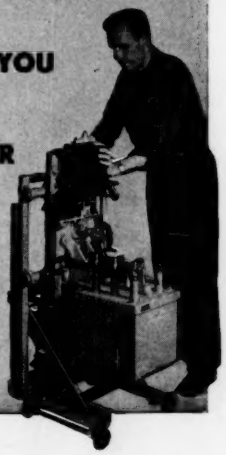
starting and synchronizing is sensitive to the electrical condition of the field winding, applying field excitation at proper rotor angle for maximum synchronizing torque with minimum current inrush . . . and it's coupled with E-M's modern field failure protective system.

FAST ACTING FUSES *plus* E-M Safety-Gang Isolating Switch in SAFUSE are the best possible combination for complete motor and control protection thru NEMA Class E-2 maximum ratings. The current limiting fuses provide short circuit protection and are carefully coordinated with overload relays as shown in diagram above.

Complete information and helpful application data are available from your E-M Field Engineer. Call him and write the factory for publications 242A and 249.

SAFUSE GIVES YOU CHOICE OF AIR-BREAK CONTACTOR OR OIL SWITCH

For highly repetitive duty use the roll-out air break contactor. But for less frequent starting—or in areas of severe dust, dirt, moisture, or corrosive fumes—the roll-out oil switch is recommended.



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disconnect high-voltage fused control

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Leather
Lithographing
Linoleum and Floor Covering
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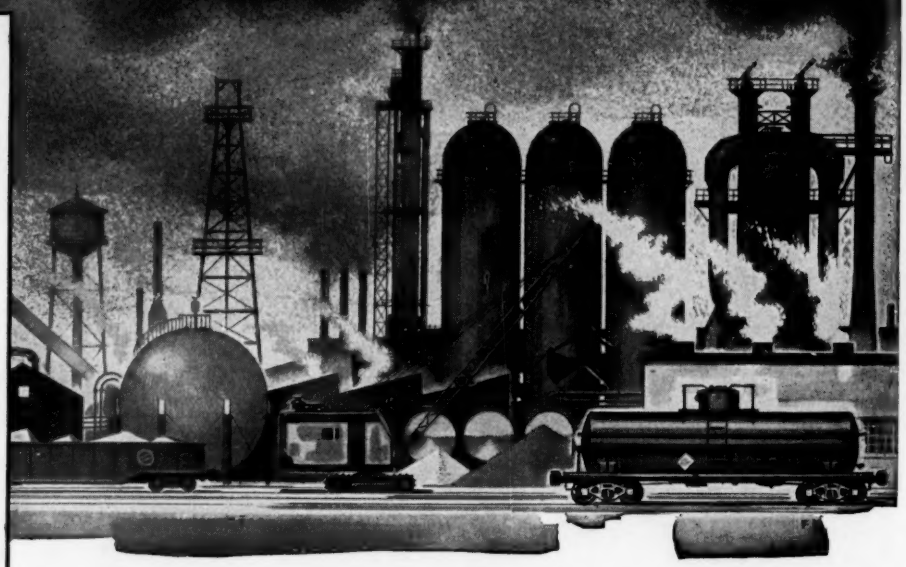
Rubber
Shade Cloth
Soaps
Textile
Veterinary Remedies
Welding Electrodes
Wall Paper



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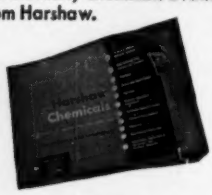
Glycerine
Preformed Catalysts, Catalytic Chemicals
Synthetic Optical Crystals
Agricultural Chemicals
Fungicides
Chemical Commodities

FREE! This 16-page booklet lists the many chemicals available from Harshaw.



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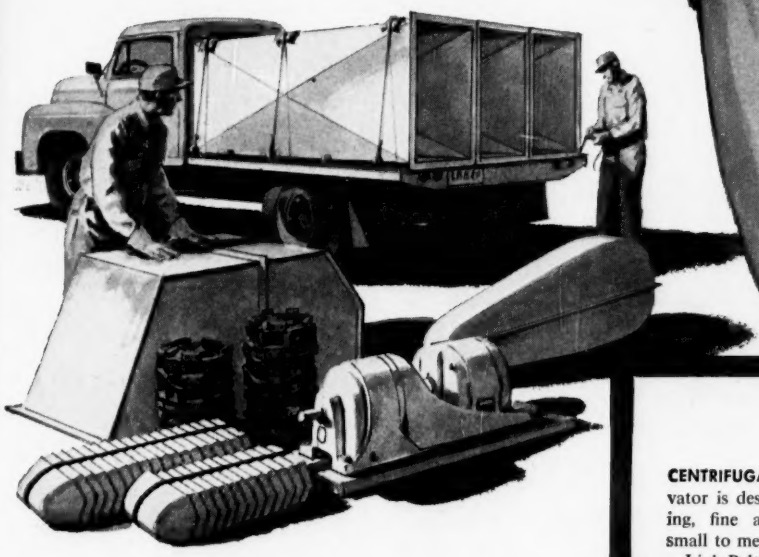
There's no delay, no purchasing or installation problems when you call on Link-Belt for your bucket elevator. And when it's up, you can count on long-term elevating efficiency. Reason: Link-Belt makes *everything that goes into a bucket elevator* . . . from head to boot! By carefully designing, manufacturing and integrating all components, Link-Belt minimizes erection time and costs . . . avoids misalignment that causes inefficiency, bucket and casing wear.

At your request, Link-Belt will gladly erect your elevator and accept full installation responsibility. For complete details, contact your nearest Link-Belt office.



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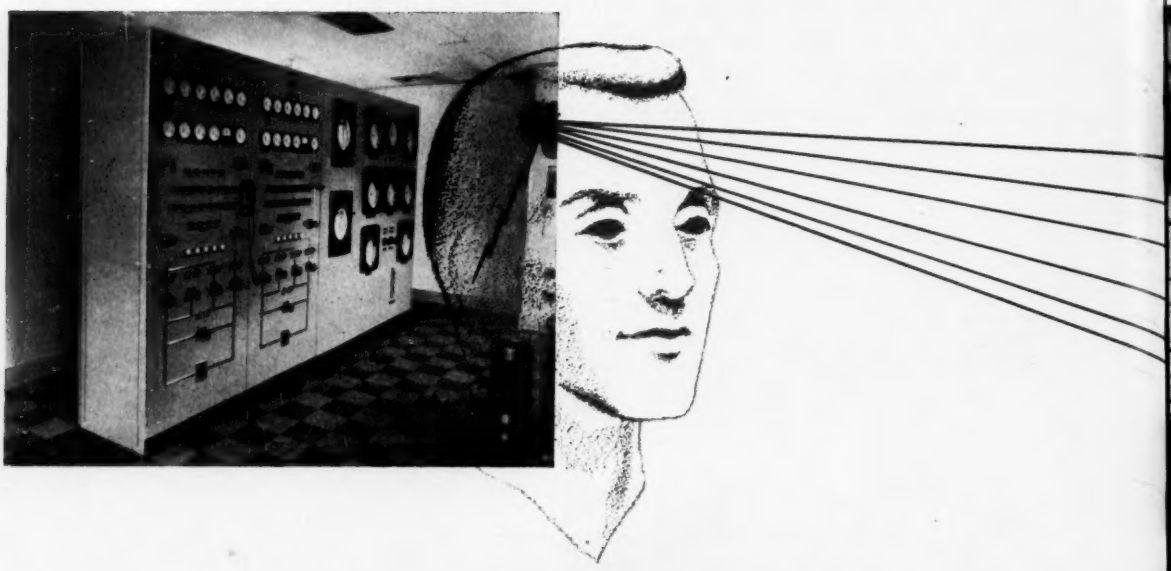
Tendamatic® control...e for unattended...m



engine-compressors with Tendamatic control operate themselves, protect themselves... truly, think for themselves!

Tendamatic control is available only for Ingersoll-Rand compressors... for any requirements, any service.

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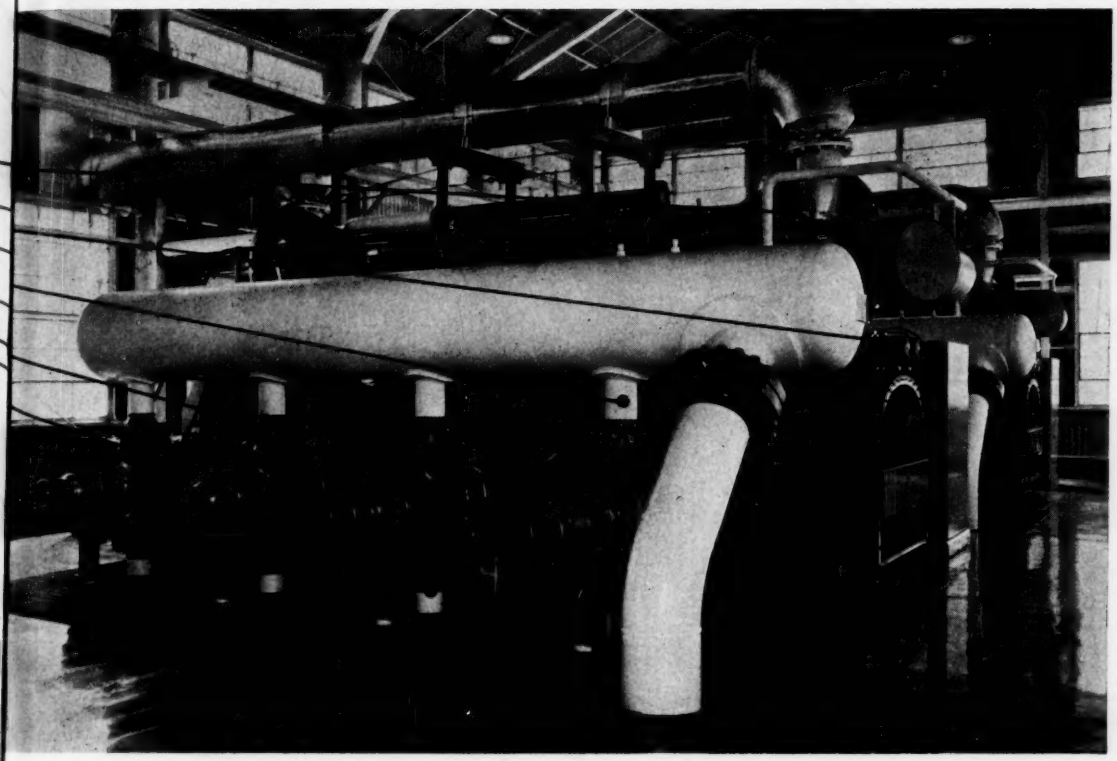
...e tireless "attendant"
...compressor installations



an Ingersoll-Rand Tendamatic control system, hases of compressor startup, regulation, super- n and protection may now be executed auto- cally or by remote control. Thus the compressor is made independent and self-sustaining, and be left to "think for itself".

engine startup, all operations are performed in er sequence and the unit is put on the line. ng operation, engine and compressor are letely, *automatically* protected against any rmal condition. On shutdown too, all operations are performed in sequence. In case of trouble, Tendamatic control gives warning, indicates the source, and if necessary, shuts down the unit.

These automatic control systems are the product of Ingersoll-Rand's Tendamatic Control Division—a specialized group of engineers and experienced production men whose job is the development, design, manufacture and application of control systems for all types of compressor installations. For more information, call your I-R representative or write for Form 3276.

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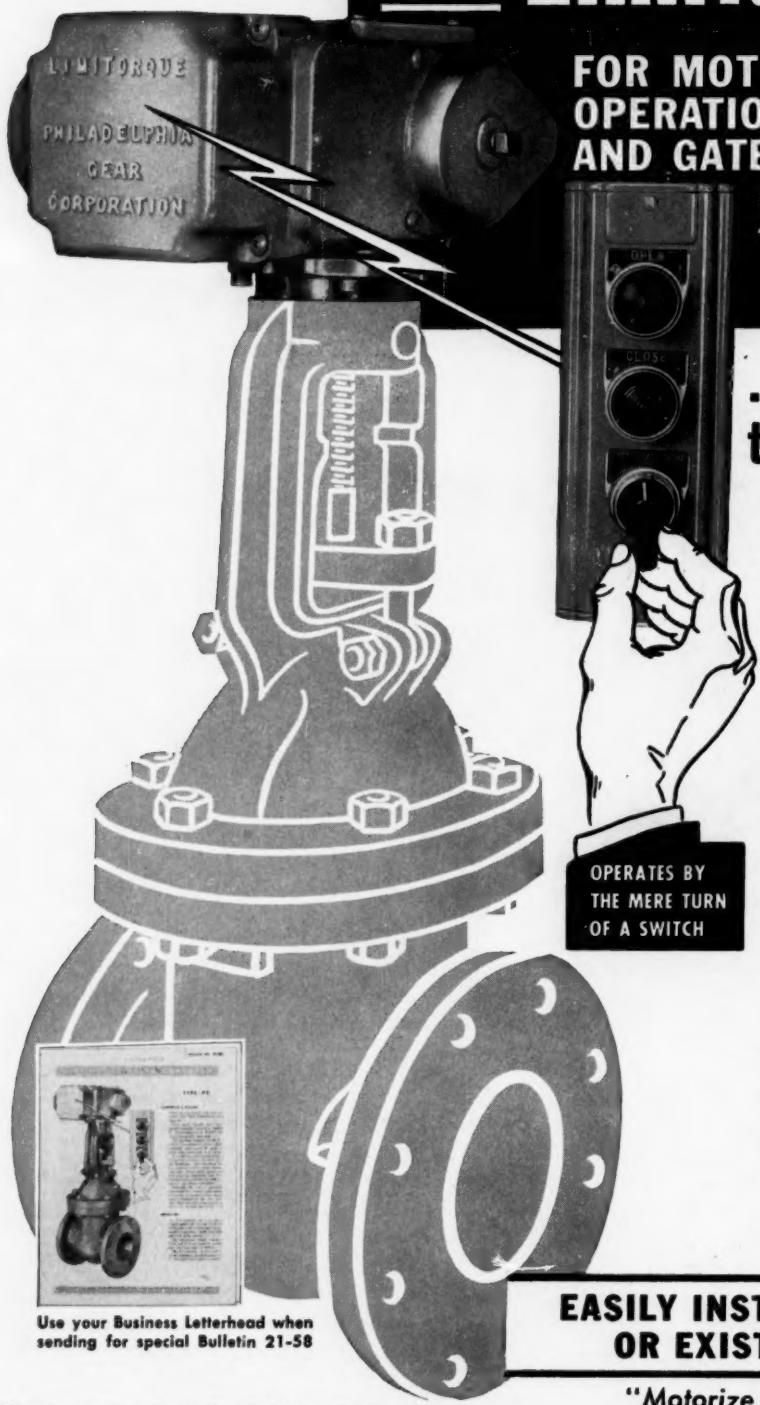
. . . Economically and Efficiently



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Here is a new, compact, economical and dependable LimiTorque Motorized Operator for use on small (normally hand-operated) Globe and Gate Valves — either new or already in service. Your existing hand-operated valves can now be easily motorized by the removal of the hand-wheel, and mounting the P-2 Unit on the same bonnet . . . the Unit output drive sleeve will then drive the hand-wheel unit, which arrangement is suitable for both rising and non-rising stem valves.

The P-2 LimiTorque Operator has a standard out-put speed of 22.5 or 45 rpm, which covers the average and recommended operating speed for most Globe and Gate Valves.

Remember, this new P-2 LimiTorque is built by the largest manufacturer of Motor Operators for Valves in the World . . . backed by nearly 30 years experience.

BE CONVINCED how the P-2 can save you time, labor and money in the operation of small valves — just write for Bulletin No. 21-58, which not only illustrates and explains its operation, but shows how easily it can be installed on existing or new valves.

Contact your Valve Manufacturer, or your nearest LimiTorque Sales Engineering Office.

Use your Business Letterhead when sending for special Bulletin 21-58

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"Motorize to Economize"

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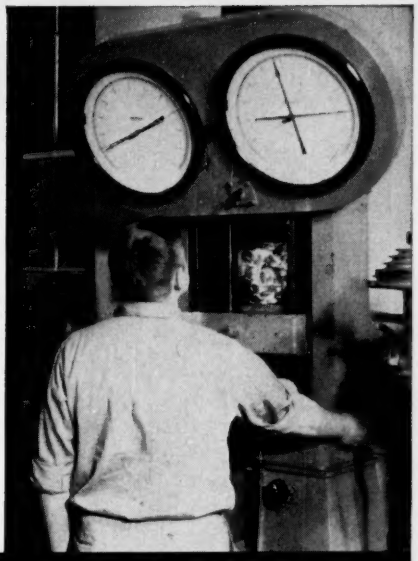

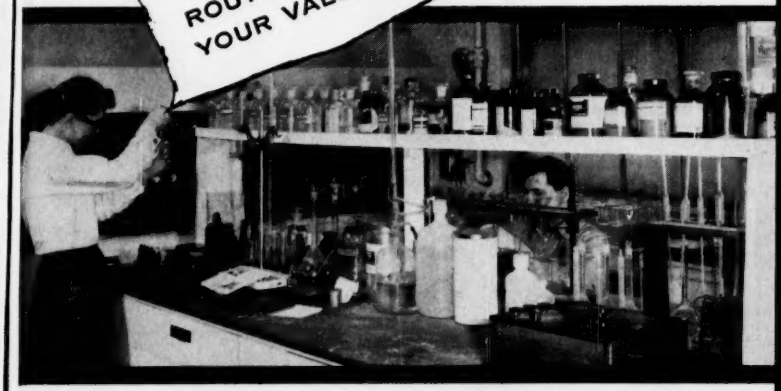

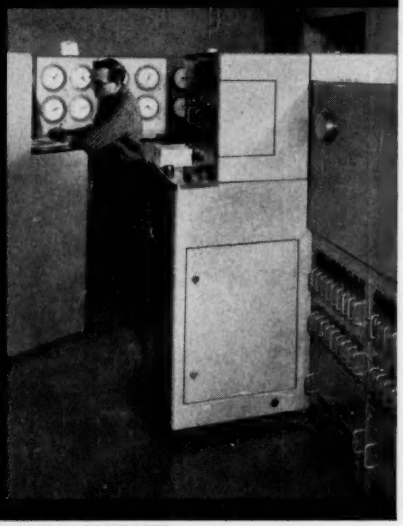

WAUKESHA FOUNDRY has one of the country's most completely equipped metallurgical and research laboratories to work for you on your corrosion-resistant metallurgical problems. Moreover, WAUKESHA FOUNDRY also provides a group of metal formulations that may completely meet your requirements in bearing or wearing qualities, corrosion, hardness or working temperatures. Here they are:

STAINLESS STEEL. 5 types. Martensitic for maximum hardness... Ferritic for use where exposed to atmosphere, water or for scale resistance... Austenitic (including the 18-8 alloys) which can be welded without subsequent heat treatment

In addition there is **WAUKESHA METAL** — a copper base, high nickel content, solid, white, highly corrosion resistant alloy. 12 WAUKESHA METAL formulations are available. Please write giving your requirements and we will make specific recommendations.

PRODUCTION facilities. WAUKESHA is the largest jobbing foundry casting exclusively in alloy castings, yet facilities and versatility are such that one casting or a long production run is welcome.

Write ... or please use the coupon below if more convenient.

Waukesha
FOUNDRY COMPANY

5905 LINCOLN AVENUE WAUKESHA, WISCONSIN

WAUKESHA FOUNDRY COMPANY
5905 Lincoln Avenue, Waukesha, Wisconsin

Please send your new technical Bulletin on Waukesha Metals and on Waukesha Stainless Steel Castings.

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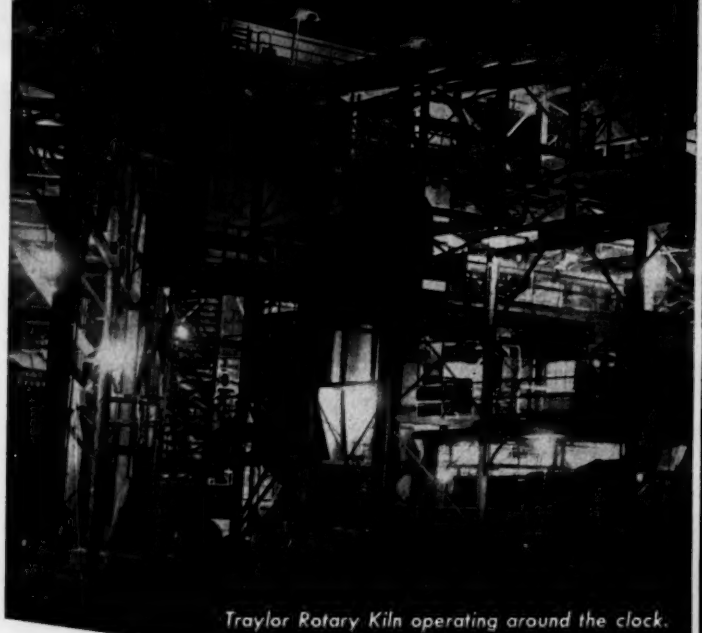
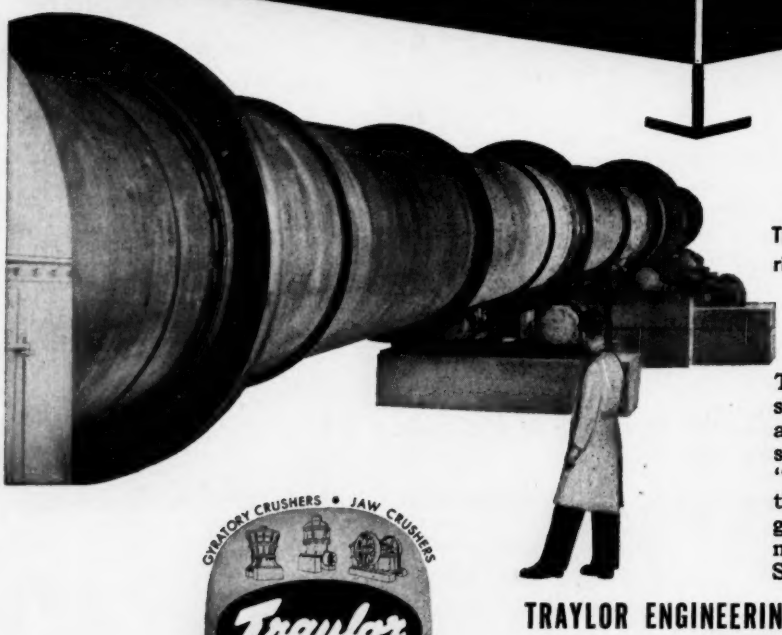
8032

Traylor-made kilns

feature Operating Economy
Advance Design
Rugged Dependability



Traylor Rotary Kiln operating around the clock.



Traylor Rotary Kiln showing riding rings and thrust roller mechanism.

Traylor is the recognized leader in designing and building rugged dependable Rotary Kilns. From the quality steel plate of the kiln shell and the "full-floating" type of roller ring to the drives and firehood — Traylor guarantees a satisfied customer. For more on Traylor Kilns, Coolers and Slakers write for Bulletin No. 1115.

GYRATORY CRUSHERS • JAW CRUSHERS
Traylor
ROTARY KILNS • BALL MILLS • APRON FEEDERS

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FULLER COMPANY
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FULLER COMPANY GENERAL
TRADE MARK

GILBARCO'S ELECTRONIC GAUGE

MEASURES.....SUPERVISES.....LOGS...

...the only measuring instrument that provides complete automation in gauging liquids and solids!

The Gilbarco Electronic Tank Gauge will indicate the level of most substances having a dialectric constant of 1.5 or higher, which covers virtually every solid and liquid known. Readings can then be transmitted over any distance to a remote station equipped with read-out recorders or data-loggers.

Case histories demonstrate its flexibility...

✔ At a major sugar refinery, a Gilbarco gauge met with acceptable results during a test period...assisting in the automation of this modern plant, a group of gauges will be used to measure continuous sugar level in storage silos.

✔ Polyethylene cubes have been measured successfully.

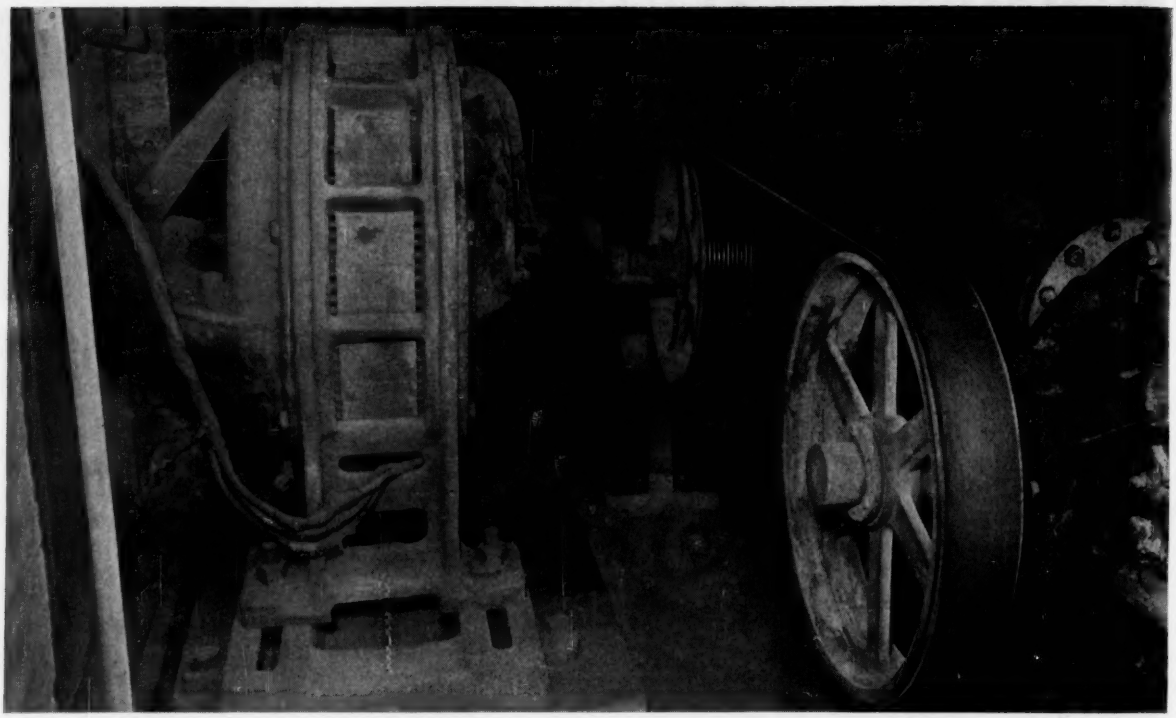
✔ An electric power plant has purchased a Gilbarco tank gauge for remote measurement of powdered soft coal in feed hoppers.

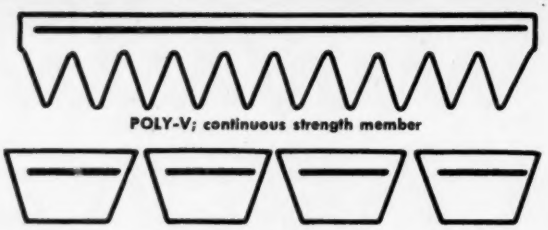
✔ Gauging of molten sulphur is another application where the Gilbarco unit is being considered.

Alcohol, asphalt, flour, wood pulp, corn and food starches are but a few of the endless commodities that can be measured. Regardless of your product, write to Gilbarco about *your* level measurement problem...

Gilbarco

GILBERT & BARKER MFG. COMPANY
West Springfield, Massachusetts





"MORE USE PER DOLLAR"

Poly-V Belt is a single unit with even, uniform pull. Uninterrupted strength member gives much higher hp capacity per inch of drive width. No belt drive delivers as much power in the same space as Poly-V!

THIS R/M POLY-V® DRIVE OUTLASTED V-BELTS 8-1!

V-belts were replaced every six months on this gas pump drive in a southern chemical plant—until the company converted to R/M's patented Poly-V Drive. The single Poly-V Belt pictured above has been in operation for over 4 years on a barium process operation. Four years for the R/M Poly-V Drive versus 6 months for an ordinary V-belt drive! The savings and advantages to production are obvious.

R/M Poly-V Drive solves difficult drive problems wherever heavy duty power transmission is required. Single unit design permits *narrower* Poly-V sheaves to deliver *equal* power in a much smaller space or much *more* power in the same space as a V-belt drive! The drive runs smoother because there's no sinking of belt in sheave grooves. Belt speed ratios remain constant from *no* load to *full* load for uniform power delivery—with less wear on belts and sheaves. V-belt "length matching" problems are completely eliminated . . . and just two belt cross sections meet every heavy duty requirement. Let an R/M Distributor show you other advantages of converting to R/M Poly-V Drive. Write for Bulletin M141.

- **More Power—Less Space**
- **Eliminates "Matching" Problems**
- **Maintains Groove Shape**
- **Assures Constant Speed Ratios**
- **Longer Belt and Sheave Life**
- **Cooler, Smoother Running**

RM1010

When You Change Drives, Convert to Poly-V and Be Sure!

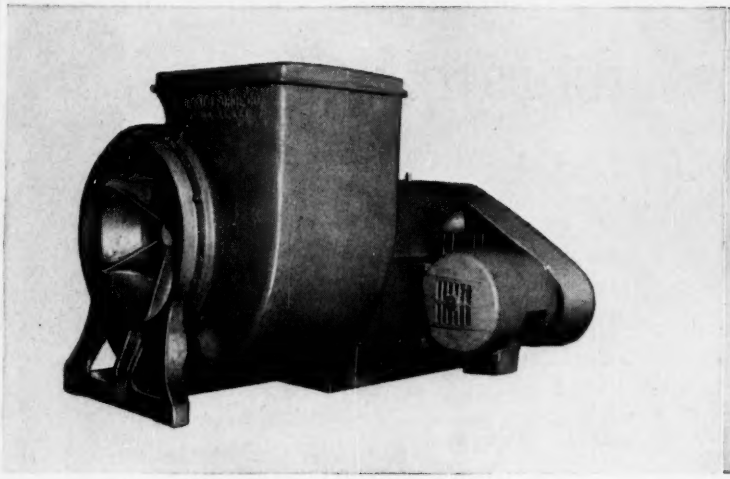
RAYBESTOS-MANHATTAN, INC.
MANHATTAN RUBBER DIVISION, PASSAIC, NEW JERSEY

RM

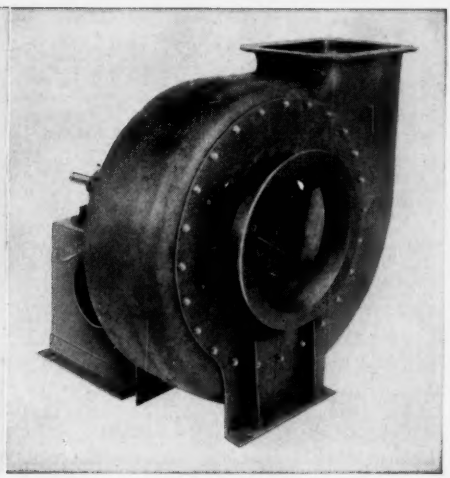
ENGINEERED RUBBER PRODUCTS ... MORE USE PER DOLLAR

CORROSIVE FUMES?

HANDLE THEM WITH THESE SPECIAL "BUFFALO" FANS



"Buffalo" Cast Iron Exhauster



"Buffalo" Fiber Glass Fume Fan

"Buffalo" Cast Iron Exhausters are built to withstand extreme corrosive conditions in the chemical process industries. High efficiency is the result of low-turbulence air flow design. This includes heavy-duty cast iron housings and cast inlet cones with integral inlet vanes. Non-overloading characteristics are preserved despite changes in system pressure. Available with direct motor drive, separate belt drive or package unit with adjustable pitch V-belt drive and motor mounted on adjustable base rails. Write us for full information.

"Buffalo" Resin-Bonded Fiber Glass Fume Fans are highly resistant to such chemical corrosives as acids, salts, gases, organic materials and others. They are suitable for temperature applications up to 300° F. The fan housing is constructed entirely of fiber glass. All exposed parts of the factory-balanced rotor are encased in thick fiber glass. Standard capacities range up to 34,000 cfm at pressures to 10″ static. Investigate the advantages of "Buffalo" Type "FG" Fume Fans—versatility, lighter weight, reasonable cost, dependability. Write for Bulletin FI-511.

These two specialized fans are representative of the air handling units engineered by the Buffalo Forge Company to help you combat the corrosive fumes encountered in many industrial processes. In addition to these fans, "Buffalo" offers rubber lined fans, fans with other special coatings and a comprehensive line of air cleaning units.

For complete details on "Buffalo" corrosive fume handling units, contact your "Buffalo" engineering representative or write us direct.

"Buffalo"

BUFFALO FORGE COMPANY

BUFFALO, NEW YORK

Buffalo Pumps Division, Buffalo, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING • AIR CLEANING • AIR TEMPERING • INDUCED DRAFT • EXHAUSTING • FORCED DRAFT • COOLING • HEATING • PRESSURE BLOWING

Now!

Double-element laboratory type Glas-Col heating tapes

This heating tape is especially designed for laboratory use . . where the tape must be applied and removed frequently. BOTH of the parallel leads of heating elements terminate at the SAME end of the tape so that a heater cord can be attached easily.

The heating elements in these tapes consist of two Nichrome ribbons running parallel to each other with an insulated space between them . . each ribbon is covered with glass braid and then with a tough, pliable silicone rubber. The tape can be attached to steel pipe by small magnets, or tied to glass tubes.

Waterproof: If water is spilled on Glas-Col heating tapes, the possibility of shorts and electrical shock to laboratory personnel is eliminated.

Flexible: Glas-Col heating tapes are extremely flexible. They're only 1/16" thick, yet are very tough and durable.

Uniform heating: Glas-Col laboratory type double-element heating tapes* produce a uniform heating pattern.

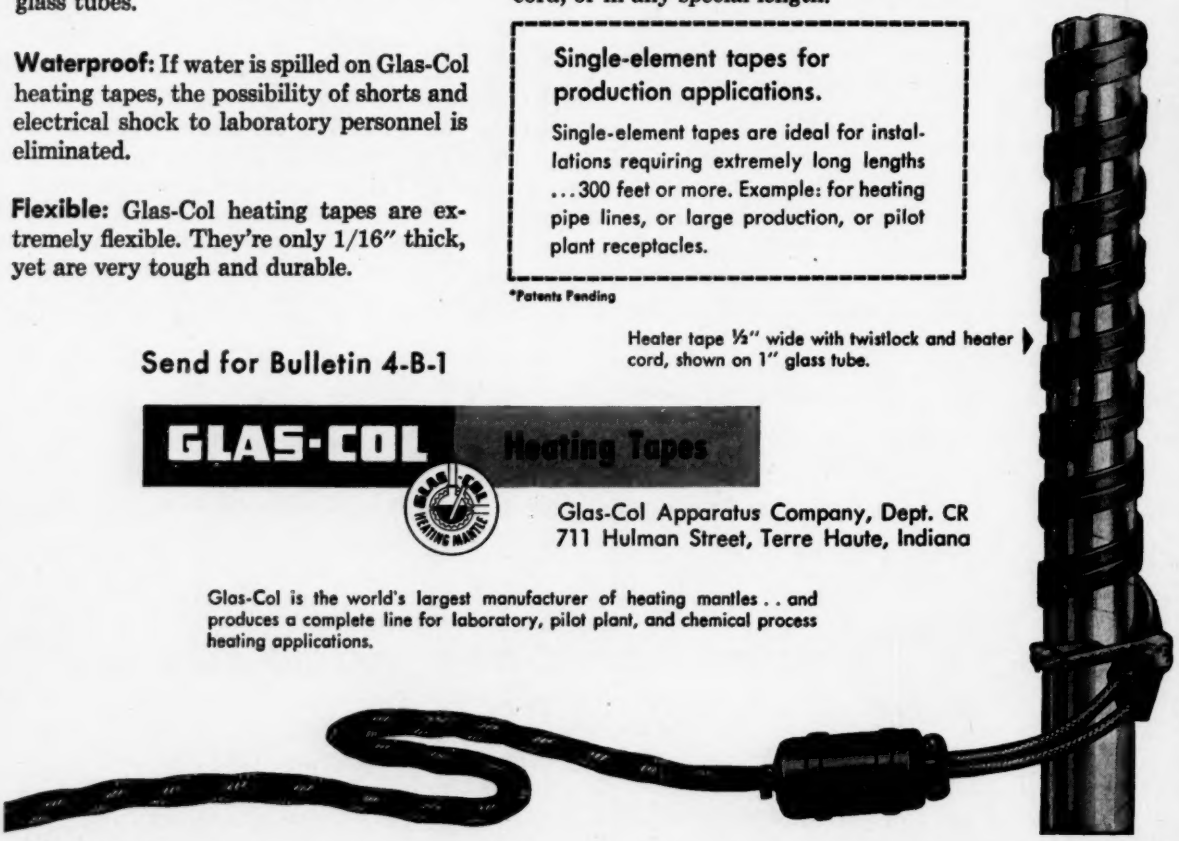
No burnouts: Nichrome heating elements will not burn out even when used far beyond assigned wattages. Glas-Col tapes are tested at 1000 volts for electrical breakthrough. They'll give years of service when used below 480°F which is the temperature limit of the tape's silicone rubber covering.

Available in ½" and 1" widths, in standard lengths from 4 to 40 ft with plug and cord, or in any special length.

Single-element tapes for production applications.

Single-element tapes are ideal for installations requiring extremely long lengths . . . 300 feet or more. Example: for heating pipe lines, or large production, or pilot plant receptacles.

*Patents Pending



Heater tape ½" wide with twistlock and heater cord, shown on 1" glass tube.

Send for Bulletin 4-B-1

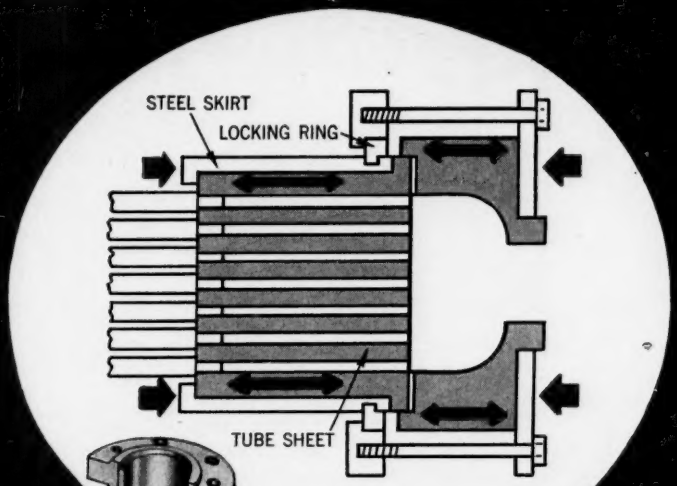
GLAS-COL Heating Tapes

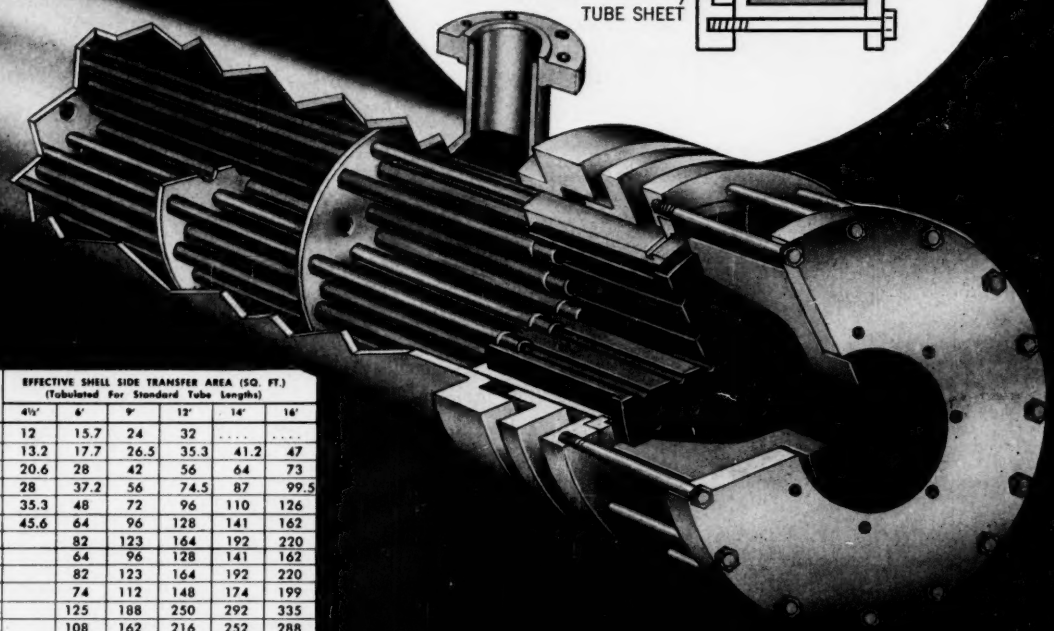
Glas-Col Apparatus Company, Dept. CR
711 Hulman Street, Terre Haute, Indiana

Glas-Col is the world's largest manufacturer of heating mantles . . and produces a complete line for laboratory, pilot plant, and chemical process heating applications.

Only

COMPRESSION HEAD DESIGN



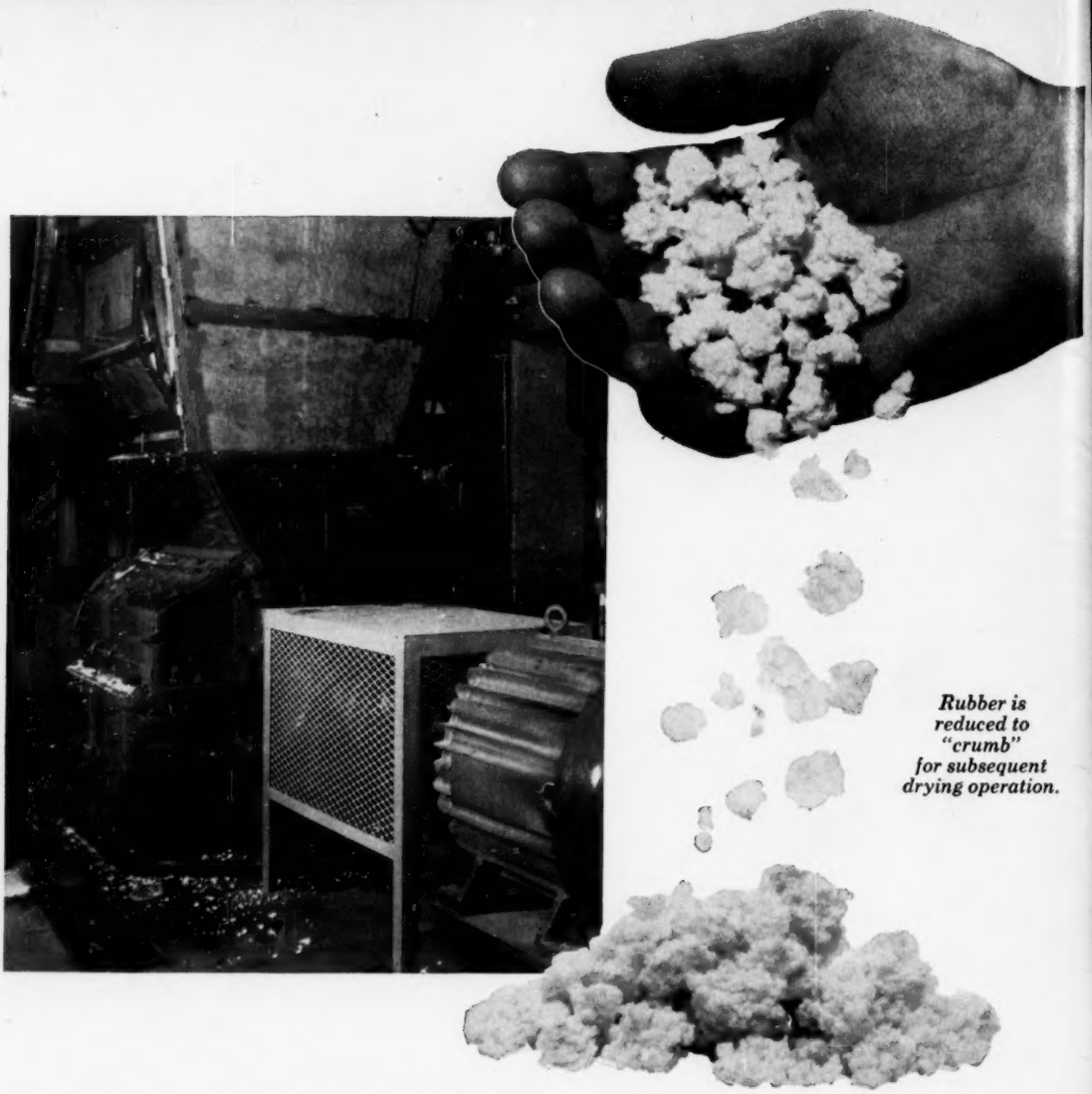


STANDARD MODELS

SHELL DIA. (IN.)	TRIANGULAR PITCH TUBE SPACING*	NO. OF TUBES	EFFECTIVE SHELL SIDE TRANSFER AREA (SQ. FT.) (Tabulated For Standard Tube Lengths)					
			4½'	6'	9'	12'	14'	16'
6	Open	7	12	15.7	24	32	....	....
	Close	9	13.2	17.7	26.5	35.3	41.2	47
8	Open	14	20.6	28	42	56	64	73
	Close	19	28	37.2	56	74.5	87	99.5
10	Open	24	35.3	48	72	96	110	126
	Close	31	45.6	64	96	128	141	162
12	Close	42		82	123	164	192	220
	Open	31		64	96	128	141	162
14	Close	42		82	123	164	192	220
	Open	38		74	112	148	174	199
16	Close	64		125	188	250	292	335
	Open	55		108	162	216	252	288
18	Close	85		166	250	332	388	445
	Open	74		145	218	290	339	387
20	Close	109		214	320	427	500	570
	Open	92		180	270	360	420	481
22	Close	130		255	383	510	595	680
	Open	121		236	356	472	554	634
24	Close	163		320	480	640	745	850
	Open	151		296	444	592	690	790
26	Close	197		386	580	772	900	1030
	Open	170		333	500	666	778	890
28	Close	235		460	690	920	1070	1230
	Open	206		405	606	810	945	1075
30	Close	268		525	790	1050	1230	1400
	Open	241		472	710	944	1100	1260
34	Close	349		685	1025	1370	1600	1830
	Open	316		620	930	1240	1445	1650
38	Close	439		860	1290	1720	2010	2300
	Open	403		802	1200	1600	1845	2140

FALLS FI INDUSTRIES, INC.

31915 AURORA ROAD • SOLON, OHIO
Phone: CHurchill 8-4343 TWX: CV-720



Rubber is reduced to "crumb" for subsequent drying operation.

JEFFREY DISINTEGRATORS

save time in processing rubber

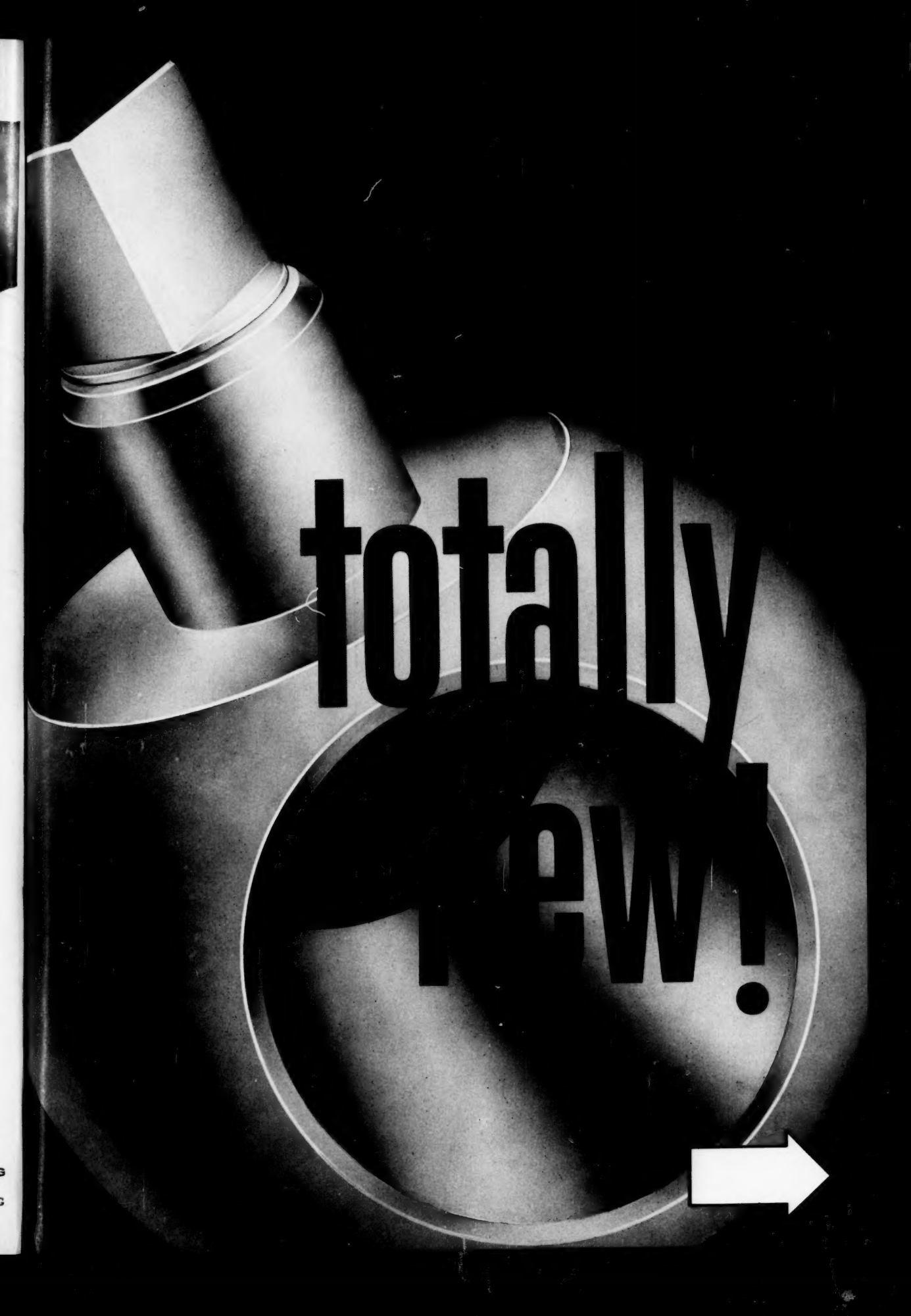
Jeffrey disintegrators quickly rip and tear slabs of wet synthetic rubber into small sized chunks for efficient drying and melting.

The disintegrators shred rubber slabs to "crumb" size of minus 2" to plus ¼" in one operation. These Jeffrey units have an excellent service record with low maintenance demands.

Jeffrey machines can reduce a wide range of materials, whether soft or hard, to the size you want. The Jeffrey Manufacturing Company, 909 North Fourth Street, Columbus 16, Ohio.

JEFFREY

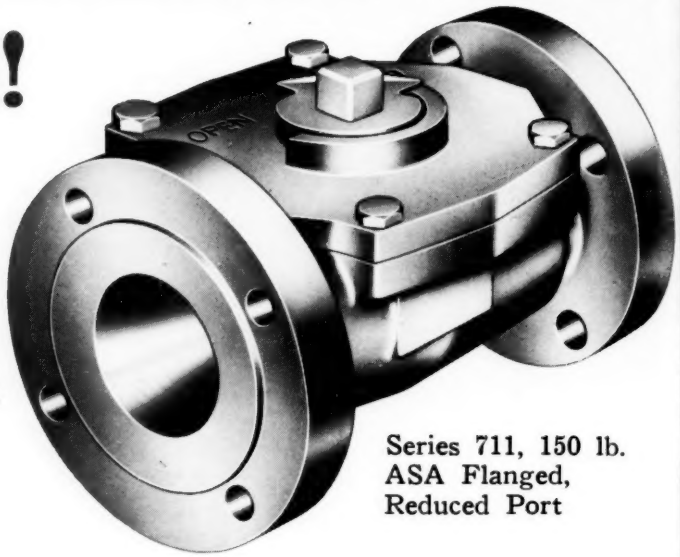
CONVEYING • PROCESSING • MINING EQUIPMENT...TRANSMISSION MACHINERY...CONTRACT MANUFACTURING


totally
new!

Only *FLO·BALL* valves are bearing-fixed for maintenance-free long life!

. . . with all the features you must have:

- **Top loading**
- **Replaceable seats**
- **One-piece ball and stem**
- **90° on-off**
- **Two-way flow**

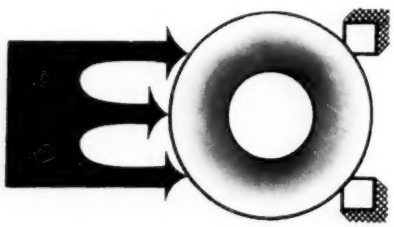


Series 711, 150 lb. ASA Flanged, Reduced Port

Now available . . . the result of years of intensive service in the missile-space industry . . . proven in thousands of adverse applications . . . now at mass produced prices . . . the most advanced line of ball valves ever manufactured . . . for you!

ORDINARY BALL VALVE

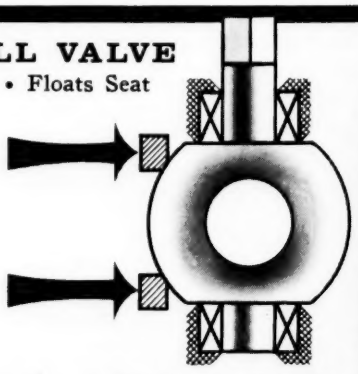
Floats Ball • Fixes Seat



Floating ball puts excessive pressure load on fixed seats. Results in distortion and short life.

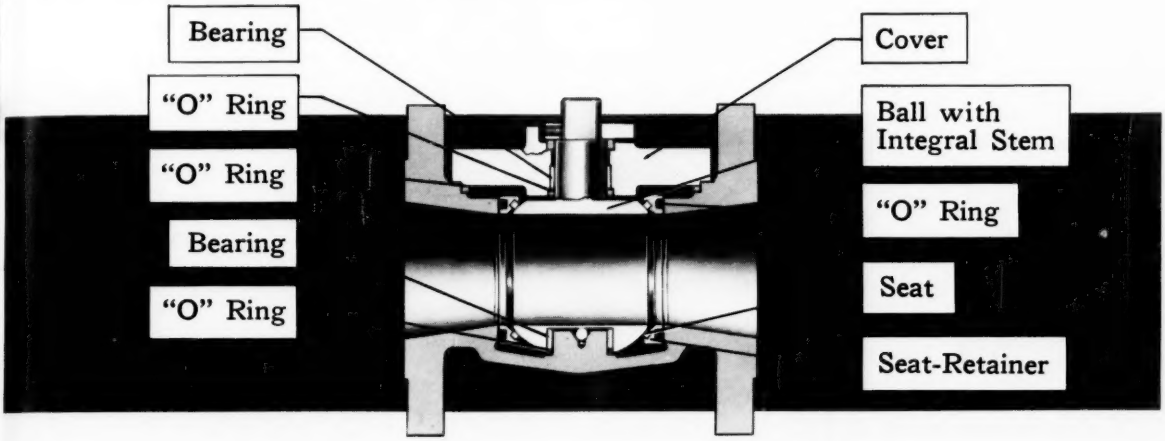
FLO • BALL VALVE

Fixes Ball • Floats Seat



FLO·BALL bearings absorb all pressure forces. Elimination of excessive seat loading insures long life.

The Series 711 ***FLO·BALL*** valves are available for off-the-shelf delivery. All are manufactured to standard ASA dimensions in semi-steel, carbon steel, 316 stainless steel, and aluminum (ASTM 356-T-6) for body and ball, Teflon for seats, and Buna "N" O-Ring seals. Other materials are also available. These valves operate at pressures to 300 psi, temperatures to 400° F.



The Hydromatics Series 711 FLO•BALL valve gives you the features you must have!

- Bearing-Fixed ball. Engineered to withstand shock and impact without distortion or backlash.
- Top loading. Valve can be disassembled and assembled without removing it from line. No special tools are required.
- Self adjusting, replaceable seats. Both balanced seats are self-aligning and self-adjusting for controlled seat loading and positive seal.
- No lubrication. Operates completely without lubrication.
- Zero leakage. At all operating pressures, including vacuum to 10^{-6} mm. of Hg.
- One-piece stem and ball. Simplified construction adds strength, precision and lower torque.
- Maximum flow efficiency. The open ***FLO·BALL*** valve provides an unrestricted, straight-thru fluid path.
- Lowest torque. Bearing-Fixed construction results in effortless, fast-action with low torque.
- Two-way flow. Exclusive ***FLO·BALL*** seat design principle insures perfect seal in both directions.

Hydromatics, Inc.

FLO· BALL

Mail this postage-free card today

Tear Along This Edge

Gentlemen:
Your Bearing Fixed Flo•Ball valves from ⅛" to 24" may help solve a problem relating to the control of:

☐ Corrosive Liquids ☐ Cryogenic Liquids ☐ Throttling Flow
☐ Vacuum ☐ High Pressure

My flow problem is_____

PLEASE: ☐ Have salesman call ☐ Send technical data

My name_____ Position_____
Company name_____
Address_____
City_____ State_____

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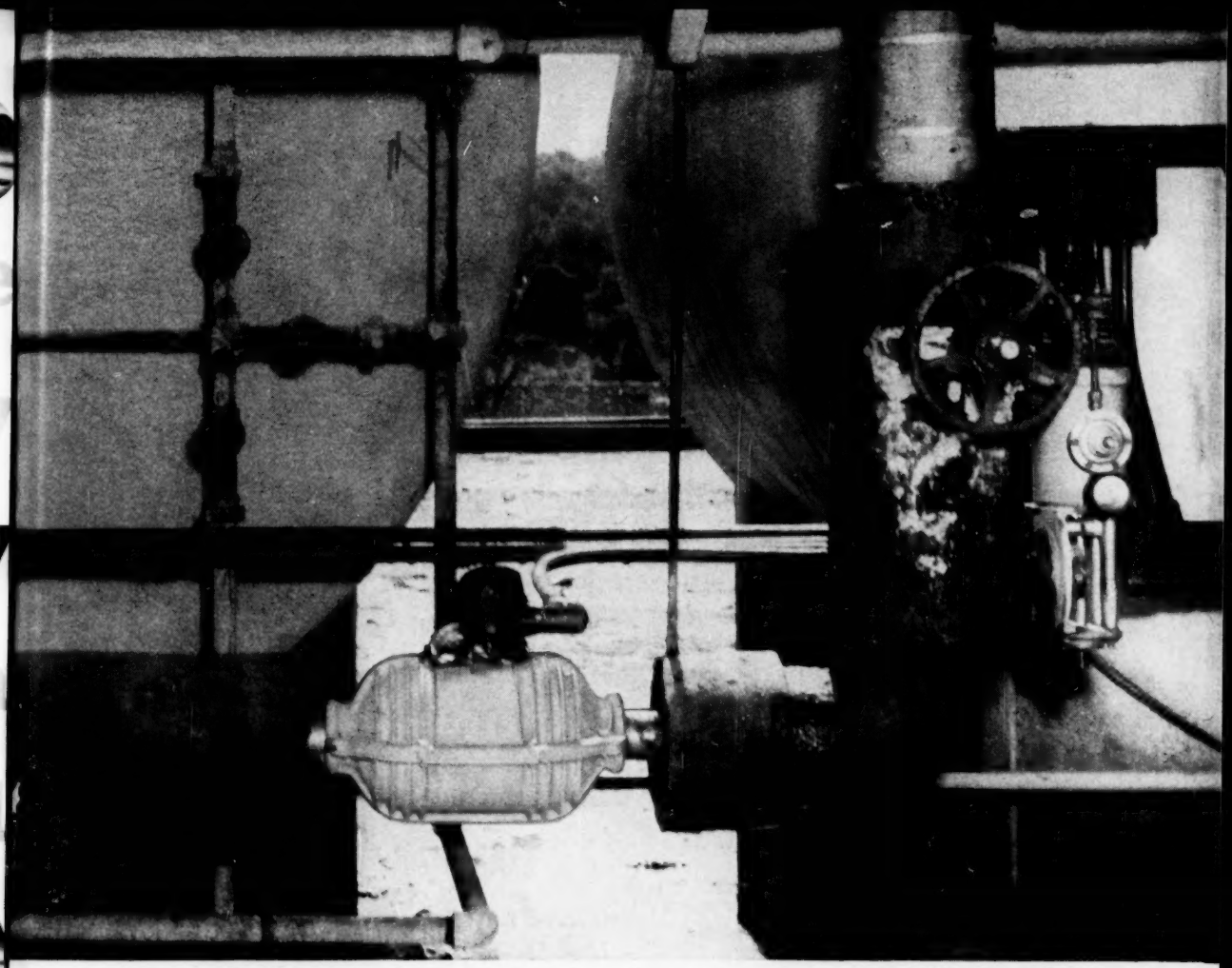


One of six Foxboro Magnetic Meters at International Salt Company's Avery Island Refinery. Meters are measuring 220°F sodium chloride brine being discharged from filters on International's Recrystallizer Process.

Foxboro Magnetic Flow Meters handle 220°F salt brine just like water!

Foxboro Dynalog Instrument indicates flow rate through any one of the 6 Magnetic Meters — at the flip of a switch.

"trouble-free" – International Salt reports

220°F — that's the temperature of sodium chloride brine as it leaves filters at International Salt Company's Avery Island Refinery in Louisiana. And their 6 Foxboro Magnetic Meters have been providing continuous, trouble-free flow measurement of this highly corrosive liquid for over a year.

These meters easily handle this punishing chemical. They're lined with corrosion-proof Kel-F — have no flow restrictions of any type. Linear measurement — accurate to ±1% across the entire scale — is indicated on remote Foxboro Dynalog* instruments.

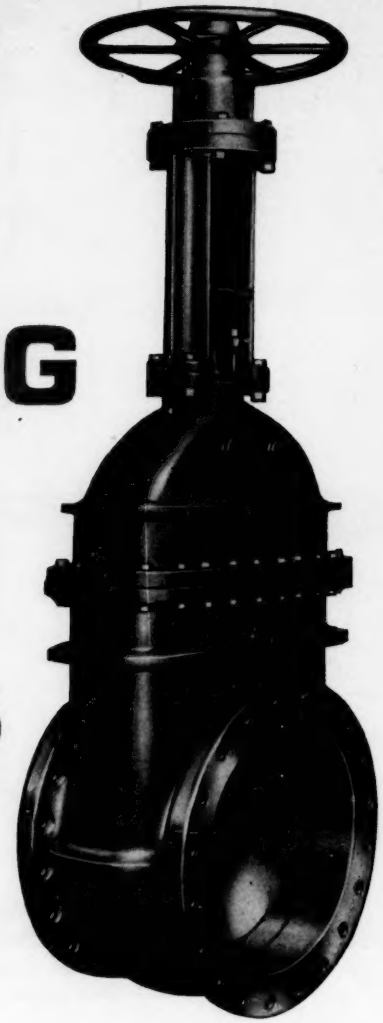
Since its introduction 5 years ago, the Foxboro Magnetic Meter has simplified the measurement of difficult liquids in hundreds of industrial processes. Ask your nearby Foxboro Field Engineer how it can help your process. Or write for Bulletin 20-14. The Foxboro Company, 362 Neponset Avenue, Foxboro, Massachusetts.

Reg. U. S. Pat. Off.

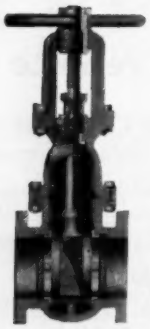
FOXBORO

REG. U.S. PAT. OFF.

HANDLING "PROBLEM" FLUIDS OR GASES?



Specify ALUMINUM GATE VALVES by Darling



Aluminum flanged end gate valve. Also available with other types of ends. Can be furnished with inside screw stationary stem.

Where you're handling highly corrosive materials... or where valve weight is a factor... Darling Aluminum Gate Valves make sound economic sense.

High-corrosion-resistant aluminum alloys... carefully selected and thoroughly tested by Darling metallurgical engineers... are used for structural and pressure-containing parts. They've been *proved-in-use* as the most generally corrosive-resistant aluminum alloys in use today.

Double disc parallel seat principle assures maximum life under the most exacting service conditions. "No pocket" discs and wedges prevent accumulation of line scale or sludge. Wedge design reduces friction to a minimum, assures positive sealing and ease of operation.

DARLING VALVE & MANUFACTURING CO.

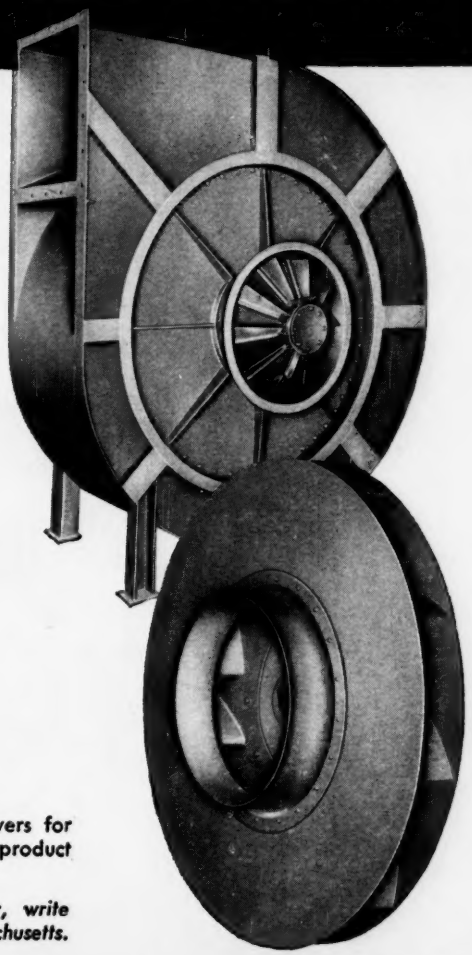
Williamsport 3, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ont.

DARLING VALVES

NEW
from
Westinghouse

PRESSURE BLOWERS
WITH AIRFOIL BLADING



only Westinghouse
HIGH CAPACITY PRESSURE BLOWERS
have these superior features

1. **EXCLUSIVE AIRFOIL BLADING**
   Lowest horsepower . . . quieter operation
2. **EFFECTIVE INLET CAPACITY CONTROL**
   Stable part load performance . . .
3. **WESTINGHOUSE DESIGNED BLOWER AND MOTOR COMBINATION**
   One source warranty . . .

Use Westinghouse Standard and High Capacity Pressure Blowers for 50 cfm-65,000 cfm, 8 oz. to 36 oz. pressure for combustion air, product cooling, liquid agitation, or process applications.

Call your nearby Sturtevant Division Sales Engineer . . . or, write Westinghouse Electric Corporation, Hyde Park, Boston 36, Massachusetts.

Westinghouse

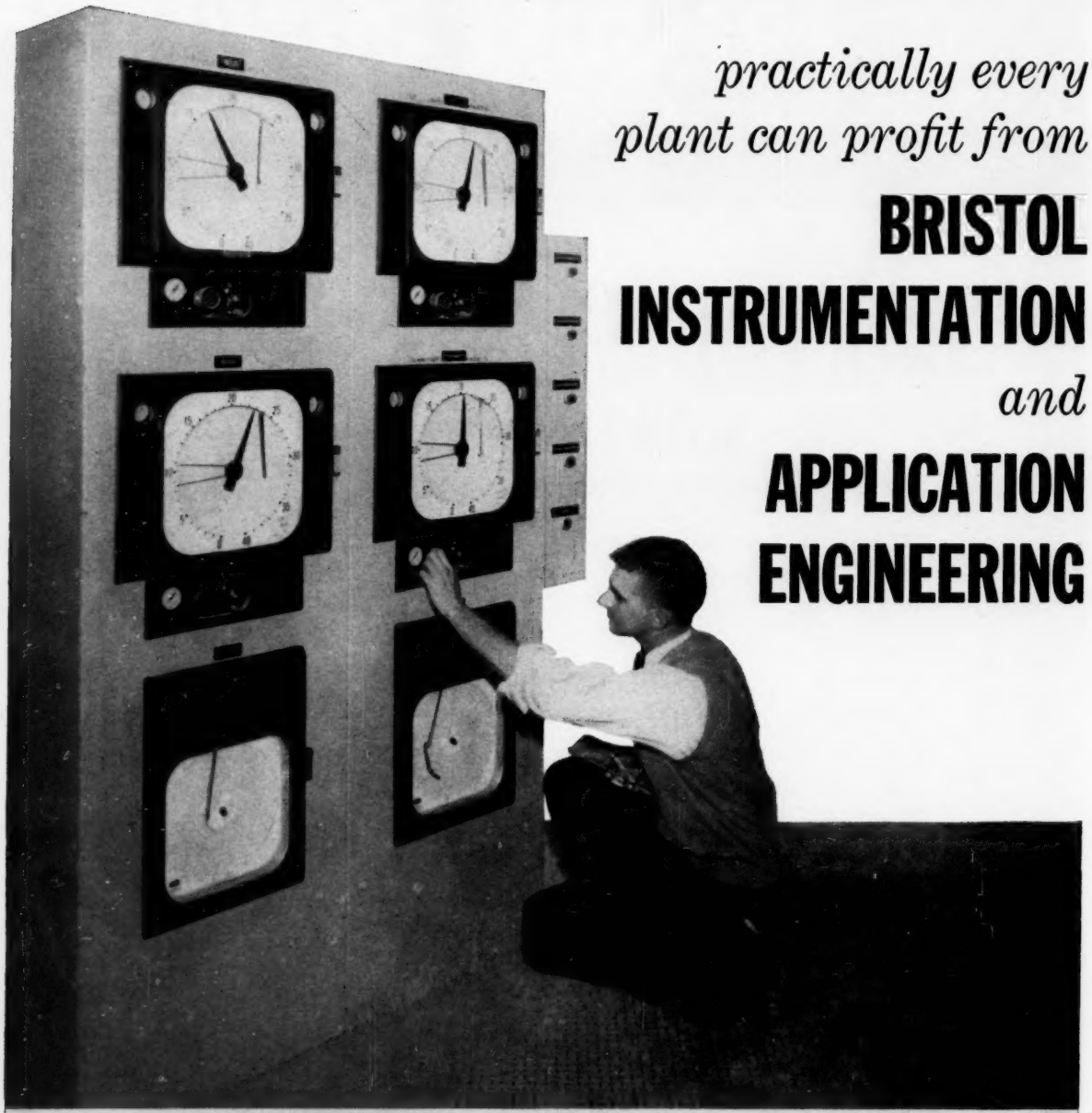
Name your process; Bristol can help you measure, record or automatically control it.

Just one example: Wood Conversion Company's new Riverside, N. J., plant with an all-Bristol process instrument installation, part of which is shown below. Here precise instrument control helps turn out, in a wide variety of forms, Balsam Wool® for housing insulation and Tufflex® used for cushion padding, sound deadening, and protective packaging. Costly human errors are eliminated, improving product uniformity and releasing valuable supervisory time for more important duties.

Whatever your plant or process, Bristol engineers —as at Wood Conversion—are always ready to work with your engineers in setting up a new instrumentation system or in modernizing and improving your existing system.

Temperature, pressure, absolute pressure or vacuum, flow, liquid level, humidity, pH, tension, thickness, speed and mechanical motion are just a few of the variables that can be recorded or exactly controlled.

Bristol makes the most complete line of instruments on the market—full-size, miniature, electronic and pneumatic types—for measurement, recording, automatic control and telemetering. Bristol's wide line insures you of the right instrument for your job, every time, and Bristol engineers are always ready to assist you in selecting it. Write: The Bristol Company, 109 Bristol Road, Waterbury 20, Conn. B-24



practically every plant can profit from

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BRISTOL...for improved production through measurement and control

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

TANK CAR DELIVERY OF MOLTEN SULPHUR

Loading Tank Cars at one of our mines

...an important phase of TGS Service

This is a service of interest to the rapidly increasing number of companies preferring to receive their sulphur deliveries in molten form so that they can transfer directly from cars into consumption. We are equipped now to deliver molten sulphur by tank car from all mines and recovery plants to any place in the country. Detailed instruction sheets and drawings are available on request for those in the planning stage or who do not have adequate or proper facilities for handling and storing molten sulphur.

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Chemical Processing Installations... Faster...Easier...More Economical

WHEN YOU START WITH FANSTEEL STANDARD STOCK EQUIPMENT

Setting up a new processing line? Need a condenser? A bayonet heater, thermowell or any other tantalum acid-proof equipment? You don't have to start from scratch.

You can start with a standard Fansteel unit—delivered from stock. For most normal applications, you'll find just the size, just the design of tantalum equipment you need *in stock* at Fansteel.

You get delivery in a hurry . . . there's no delay in setting up new installations . . . little interruption to production schedules when replacing equipment. It's the easy way . . . and it's the economical way.

As the oldest and largest manufacturer of acid-proof tantalum equipment, Fansteel is able to produce in quantities that mean substantial savings. You eliminate at the outset the high costs of designing and building custom units. And you also get the benefits and economies of doing business with the only supplier of tantalum equipment who performs the entire job—from ore to metal to the finest corrosion control equipment available.

IMMEDIATE DELIVERY ON THESE SIZES—FANSTEEL TANTALUM EQUIPMENT

BAYONET HEATERS

Single Tube

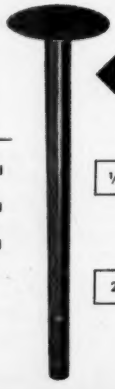
Length	Diameter
18"	1"
30"	1½"
48"	1½"
60"	1½"

Three-Tube

Length	Diameter
69"	1½"

TAPERED CONDENSERS

Length	Diameter
36"	3"-wide end 2"-narrow end
60"	6"-wide end 2"-narrow end
60"	8"-wide end 4"-narrow end



THERMOWELLS

Stocked Tubing I.D.:

½"	¾"	⅞"	1"	1¼"

Stocked Flange O.D.:

2"	2⅞"	3⅜"	5"	6⅜"

G601

FANSTEEL

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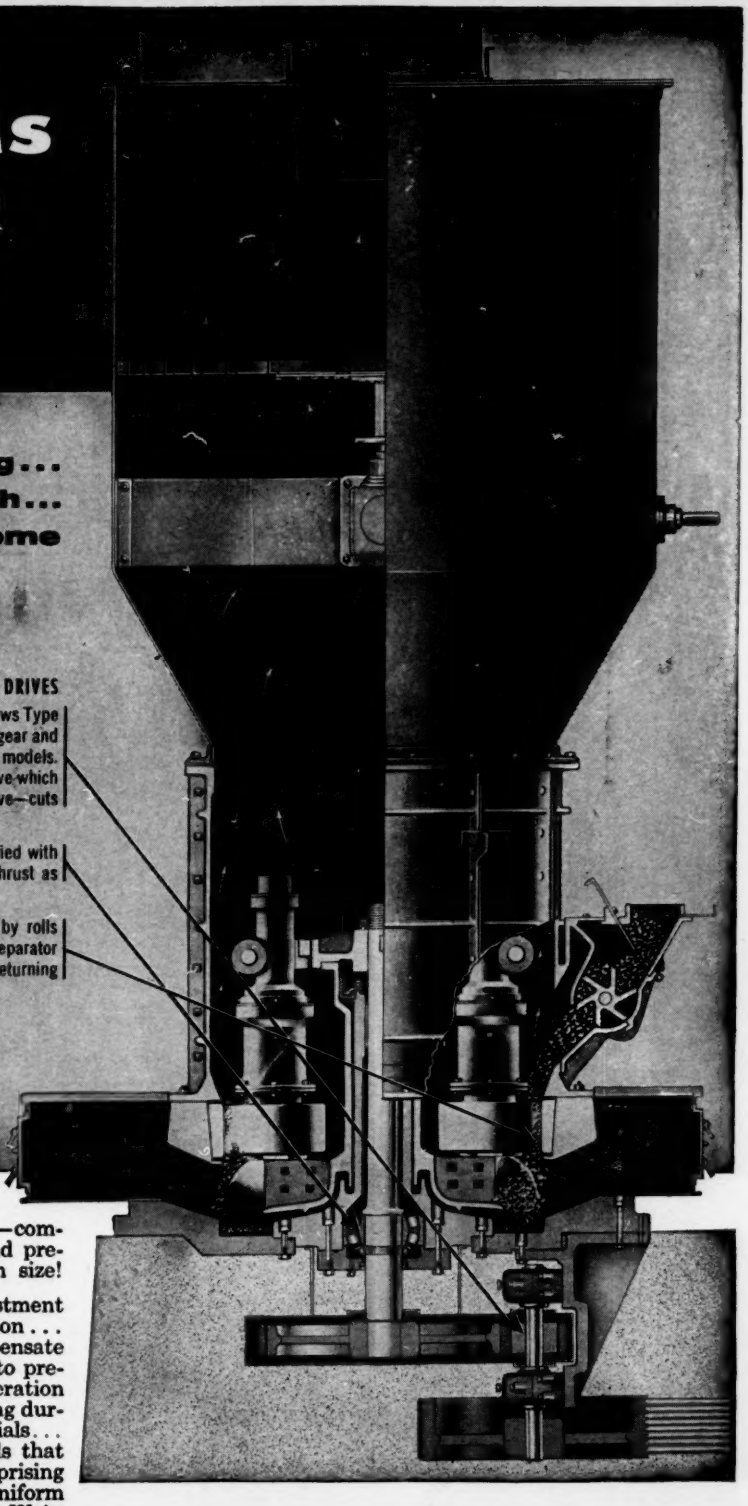

EXCLUSIVE GEARLESS AND SPUR GEAR DRIVES

Another Williams advancement! Cutaway shows Type D Mill with Spinner Air Separator with spur gear and pinion drive used on Standard and larger models. Smaller sizes have simple gearless V-belt drive which is easier to maintain than bevel gear drive—cuts labor and downtime.

Bearing alignment of central shaft is simplified with only 2 bearings, the bottom one carrying thrust as well as radical load.

NOTE FLOW OF MATERIAL being ground by rolls rotating against bull ring, then air-swept to separator which discharges finished product while returning coarse tailings for regrinding.

From raw material to finished product—completely automatic grinding, blending and precision classifying to 20 mesh or micron size!

Self-adjusting feed rate . . . instant adjustment for sizing, even while mill is in motion . . . continuous automatic take-up to compensate for wear . . . constant rising air current to prevent build-up of fines and inefficient operation . . . automatically controlled hot-air drying during grinding of moisture-carrying materials . . . all are features of Williams Roller Mills that virtually guarantee increased output, surprising cost reductions and exceptionally high uniform quality. Get all the facts immediately . . . *Write today for catalog.*

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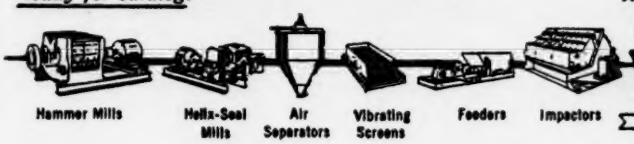

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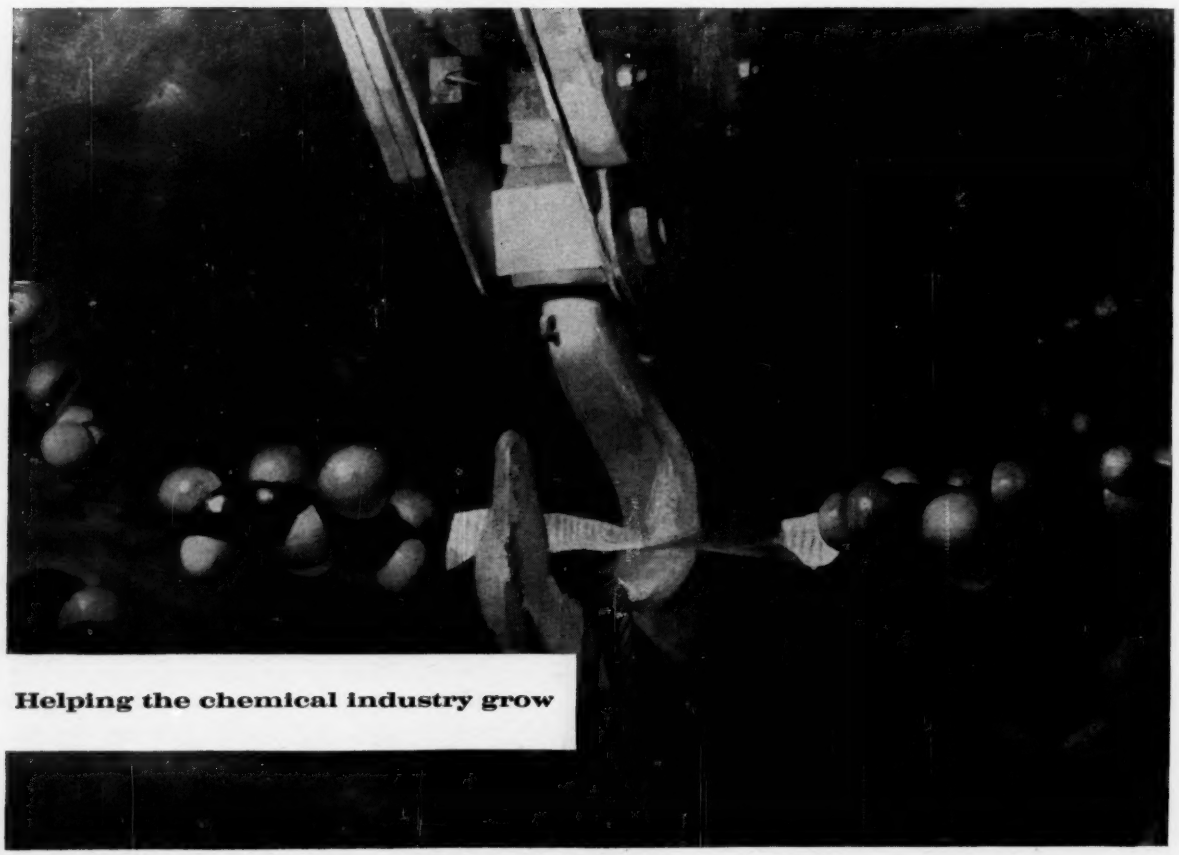
Painting by Stanley Meltzoff



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MODEL AA

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NEW Oil Burner

NEW Gas Burner

NEW Compactness

NEW Lower Fuel Costs

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NEW More Convenient Controls

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The **NEW** Model AA AMESTEAM GENERATOR offers the ultimate in steam generating efficiency and reliability.

The **NEW**ly designed low pressure air atomizing oil burner will cleanly and uniformly burn all commercial grades of oil — #4 with little or no preheat — for more efficient, economical firing. Since electric pumping and preheat loads are lower, power costs are greatly reduced. For gas firing the **NEW** ring type burner provides a more uniform flame pattern for cleaner, more efficient combustion.

All Model AA AMESTEAM GENERATORS are designed to operate at top efficiency over a modulation range of 20% to 100% of rating.

The Model AA incorporates Ames' time-proven 3-pass concentric tube design, single one-piece baffle and one-piece flue covers. Easier access is provided for inspection and servicing. The **NEW** ultra-compact design simplifies positioning and installation. All units are factory-assembled and fire-tested.

Before you buy a package boiler get the facts on the all **NEW** Model AA AMESTEAM GENERATOR.

AMES IRON WORKS, INC.
OSWEGO, NEW YORK

AMES IRON WORKS, INC., Box S-20, Oswego, N. Y.

Please send me full details on the **NEW** AMESTEAM GENERATOR Model AA Package Boiler.

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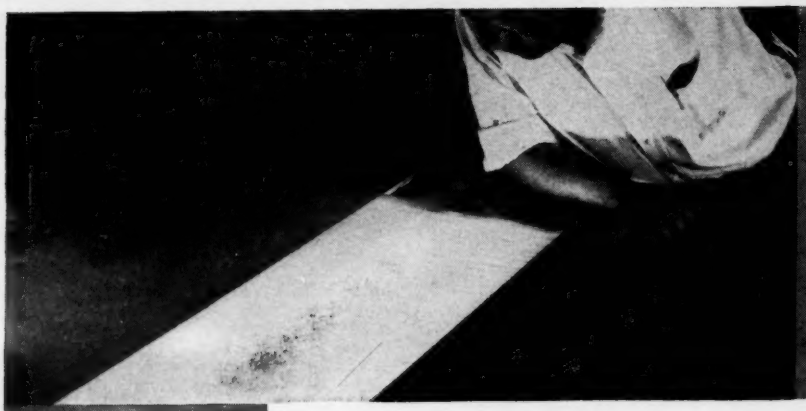

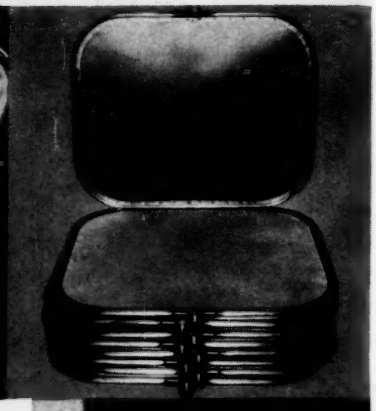

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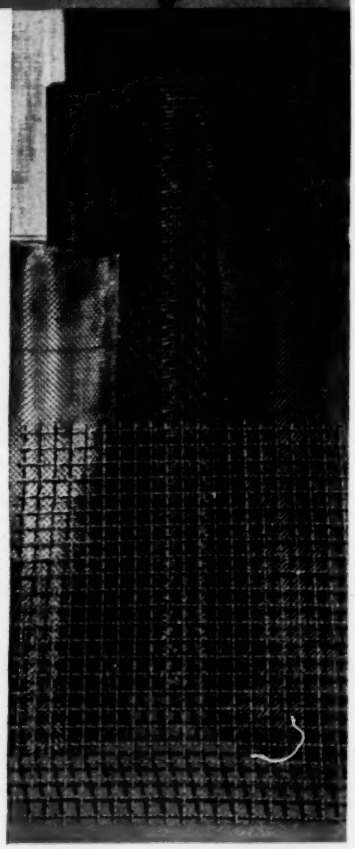
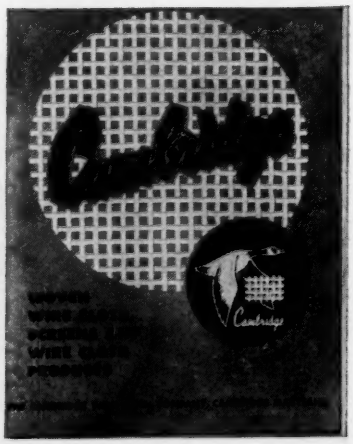
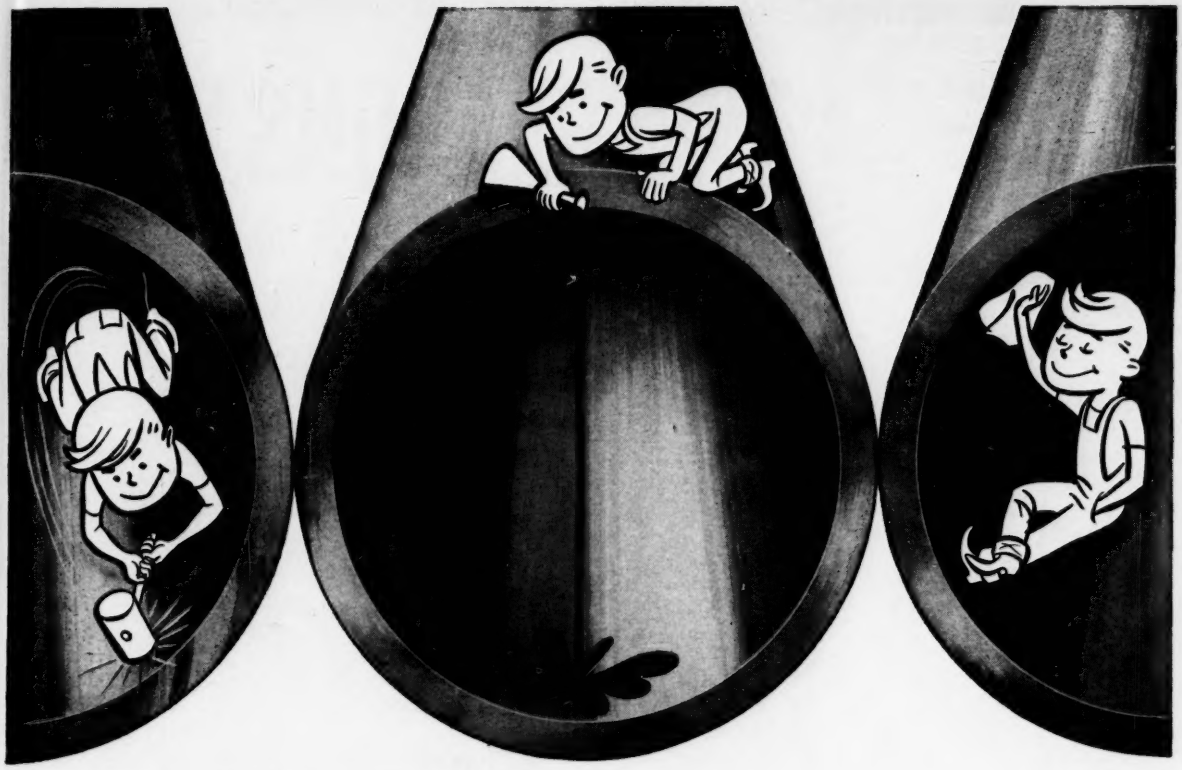






The smoother surface of CONTOUR-WELDED* STAINLESS TUBING *gives it greater resistance to corrosion*

Recent tests prove: (1) *Contour-welded* tubing is smoother than any other tubing, and (2) this extra smoothness provides greater resistance to corrosion.

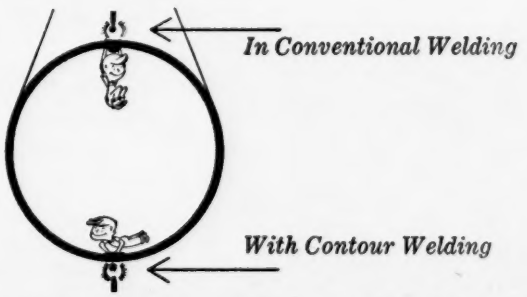
Here's how TRENTWELD® tubing, made by the exclusive *Contour-Weld* process, compares with other full-finished tubing:

- It's smoother than seamless because it's formed from uniformly rolled strip steel, whereas seamless is extruded or pierced.
- It's smoother than other welded tubing because the *Contour-Weld* process, patented by Trent, virtually eliminates the weld bead.

Other tests prove this smoother surface provides *increased resistance to corrosion* — because there are fewer focal points for corrosive attack. Not only that, the smoother surface ensures *longer fatigue life* and *less product incrustation.*

But get full details. Our free 48-page *"Trentweld* Manual" gives complete data on *Contour-Welded* tubing in sizes from ⅛" to 40" O.D., in stainless and high alloy steels, titanium, zirconium, zircalloy and Hastelloy.† Write: Trent Tube Company, Box 2518, Pittsburgh, Pa.

†Trademark Haynes Stellite Co.



In CONVENTIONAL WELDING of tubes, gravity pulls the molten metal down to form a bead that is difficult to remove by cold working. And cold working may lead to undercuts, focal points for fatigue cracks and corrosive attacks. Cleaning becomes difficult.

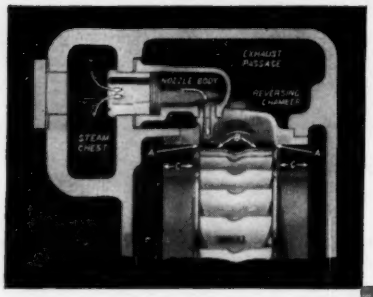
***With CONTOUR-WELDING** the tube is welded at the bottom. Gravity still pulls the molten metal down inside the tube, but now the weld area corresponds to the contour of the tube. There's virtually no weld bulge on the inside surface. And even on the O.D., the weld seam more closely conforms to the contour of the tubing.

CONTOUR TRENTWELD

stainless and high alloy pipe and tubing

TRENT TUBE COMPANY

Subsidiary of Crucible Steel Company of America • GENERAL OFFICES: East Troy, Wisc. • MILLS: East Troy, Wisc.; Fullerton, Calif.



TWO REASONS WHY

this turbine seldom sees down time

1 ***Generous wheel clearances:*** AA —rim clearance, B—blade clearance, CC —side clearance. Blades can't foul as they are protected by rims. Rubbing at AA will do no damage. Side clearance is so large (about one inch) that end-play from excessive external thrust cannot damage wheel.

2 ***Blade wear is of little consequence.*** In a Terry solid-wheel turbine, the steam enters the buckets at right angles to the shaft. As its power-producing action takes place on the curved surfaces at the backs of the buckets, wear does not materially affect horsepower or efficiency.

To prevent costly shutdowns for repairs, Terry builds bonus reliability into each solid-wheel turbine. Two of the ways in which this is accomplished are shown in the diagrams at the left.

Further details of these simple, fool-proof turbines are illustrated and described in bulletin S-116. If you do not already have a copy of this publication, send for one today. No cost or obligation.

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

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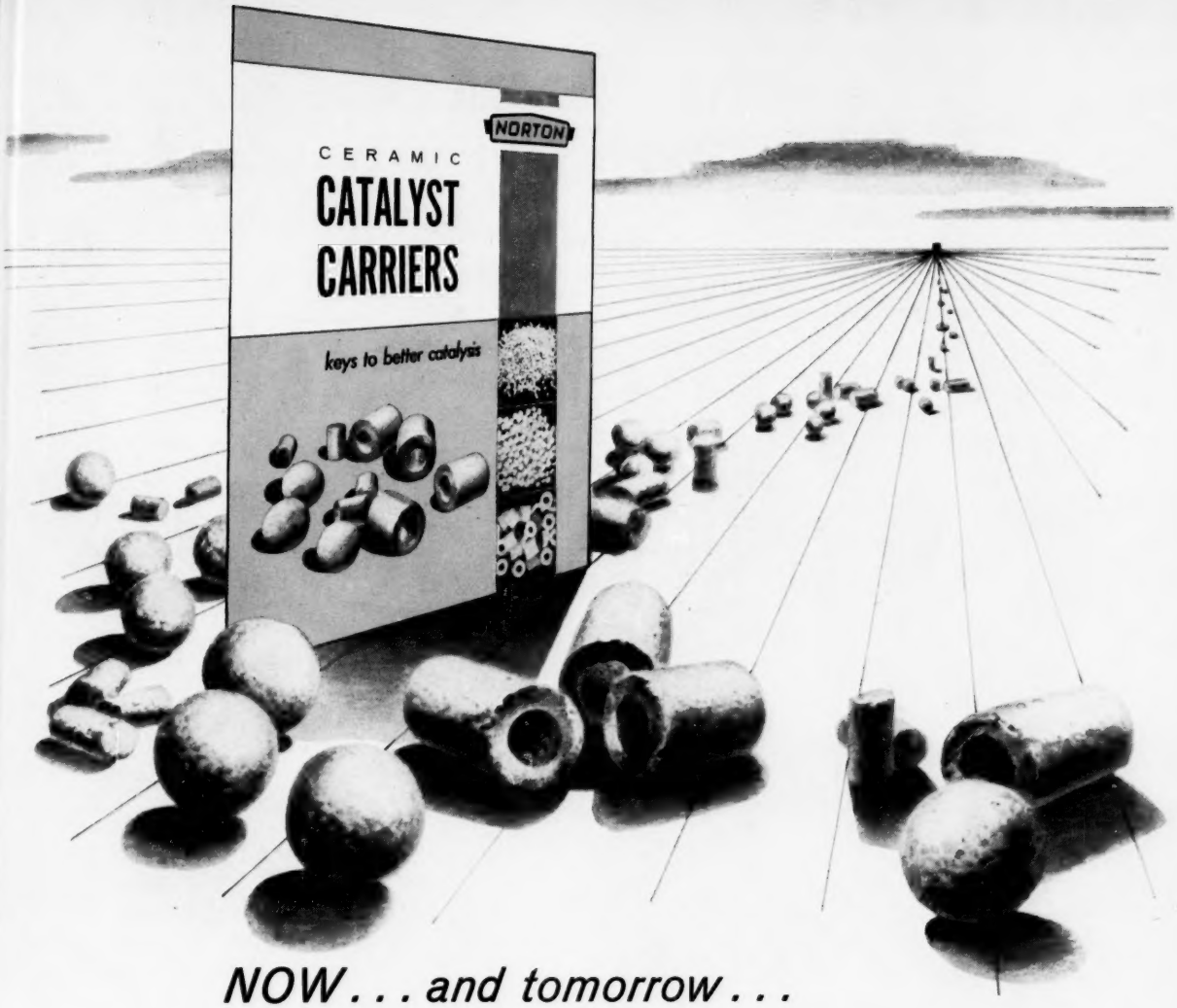
TERRY



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choose NORTON Ceramic Catalyst Carriers

In columns and reactors throughout the chemical and petrochemical industries, NORTON Ceramic Catalyst Carriers are helping processors to improve catalyst activity and life, lower catalyst costs, get optimum yields from reactions.

It's *consistent* high performance too, because *every* NORTON Carrier is uniform in *any* quantity from lot to lot. Size, weight, porosity, and purity are held to close tolerances. Duplication of specifications is assured.

Today, probably the most widely-used NORTON Carrier is alumina . . . in ring, sphere, and pellet form and as granules and powder. However, as new feedstocks are developed, and more demanding physical, chemical, and thermal conditions are encountered, new NORTON Carriers will be ready to meet catalysis specifications. For example, various materials are now available in experimental quantities as spheres, rings and pellets . . . in alumina, magnesia-alumina spinel, fused magnesium oxide, silica, zircon, zirconia and silicon carbide. These NORTON developments offer porosities ranging from 4% to 65%; surface areas from less than 1 to 70m^2/gram (BET method).

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It's the Nash!

There are no mechanical complications in a Nash Compressor. A single moving element, a round rotor, with shrouded blades, forming a series of buckets, revolves freely in an elliptical casing containing any low viscosity liquid. This liquid, carried with the rotor, follows the elliptical contour of the casing.

The moving liquid therefore recedes from the rotor buckets at the wide part of the ellipse, permitting the buckets to fill with gas from the stationary Inlet Ports. As the casing narrows, the liquid is forced back into the rotor buckets, compressing the gas, and delivering it through the fixed Outlet Ports.

Nash Compressors produce 75 lbs pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure. Since compression is secured by an entirely different principle, gas pumping problems difficult with ordinary pumps are often handled easily in a Nash.

Nash simplicity means low maintenance cost, with original pump performance constant over long periods Data on these pumps sent immediately on request

No internal wearing parts.

No valves, pistons, or vanes.

No internal lubrication.

Low maintenance cost.

Saves floor space.

Desired delivery temperature automatically maintained.

Slugs of liquid entering pump will do no harm.

75 pounds in a single stage.

NASH ENGINEERING COMPANY

313 WILSON, SO. NORWALK, CONN.

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New Cold Caustic Bleach Process

Looking for a way to use greater amounts of low-cost, more plentiful pulp—without capital investment for bleach equipment? Then let a Becco Sales Engineer show you our new technique* which allows you to bleach in the same equipment regularly used for the manufacture of cold caustic pulp.

In this new process, peroxide bleach liquor is added at the Bauer Refiner, and bleaching occurs during the refining operation. Bleach response depends on refiner densities.

Up to 20 points brightness increase has been obtained in commercial operations to date, and with no additional steam costs, no holding time, and no excessive chemical costs.

Becco can assist you immediately in setting up a production run and evaluating results. First step: use the coupon to let us know you're interested.

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If one of our patents can help you, we'll be glad to license the rights to you **perpetually,** for just one dollar. You get a nice certificate, incidentally, to cover the legalities, but more important – you also get free our complete engineering help in setting up your process, handling the material, maintenance, etc., etc.

What do **we** get? You as a **customer** – we hope – but there's no obligation on your part. Just seems to work out that way, though – when we know enough about a particular peroxygen to hold a patent on its use, chances are we've also learned enough to produce it purer than anyone else. You benefit from this; we do, too.

Use the coupon below to ask for a Sales Engineer – or our list of patents – that may help you solve an important problem.

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- ☐ Hydrogen Peroxide
- ☐ Peroxygen Chemicals
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- ☐ Please have a Sales Engineer call.

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Becco's Four-Fold Engineering Service Program—offered free—includes:

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Corrosive attack here is terrific...

but TYGON® stops it in its tracks!

The extreme corrosive conditions found in metal finishing departments pose some of the toughest coatings problems for corrosion engineers. Here, pickling and plating equipment, as well as structural steel and fixtures, are under constant attack from fumes and spillage of corrosive acids and salts.

Wherever the going is roughest — on tanks, conveyors, ventilators, walls and ceilings — you'll find Tygon is usually the recommended coating. Why? Because Tygon Paint has a proven record of success against corrosion. Tygon lasts longer, continues to give protection in many cases long after other paints have failed, thus costs less in the long run.

Another important factor is that the broad Tygon line permits application of *specialized* protection against a wide range of specific corrosives and exposure conditions. If a vinyl-base coating seems best for the job, one of several Tygon formulations may be specified. If epoxy type coatings are required, Series "E" Tygon Epoxy Coatings offer excellent, long-lasting protection under the conditions for which they are recommended.

Try Tygon on your next stubborn corrosion problem. Bulletin 760 gives the complete Tygon Coatings story. Write for it today.

PLASTICS & SYNTHETICS DIVISION

U. S. STONEWARE
AKRON 9, OHIO

110-G

DEVELOPMENTS . . .

FEBRUARY 8, 1960

Chementator

T. PETER FORBATH

Socony Mobil finds that tetramethyl lead makes a better antiknock gasoline additive than tetraethyl lead, especially for foreign auto engines. Esso, Ethyl and Du Pont support this view.

A $15-million, four-company partnership has been formed to exploit the Athabasca (Canada) oil sands. Imperial, Richfield, Royalite and Cities Service will conduct pilot plant studies on Cities' $3.5-million, 3,000-bbl./day facility at Mildred Lake, Alberta.

Food Machinery & Chemical has entered the epoxy business with what's described as a markedly new family of resins.

Louisville University has a $5,000, 6-mo. contract from Kentucky to study effects of nuclear radiation on coal. Goal is to put atom to work aiding state's faltering coal industry.

Manganese plant to score process first

A process "first" will be scored by a $6.7-million manganese refinery to be built next year either at Durango or Grand Junction, Colo., or Castle Gate, Utah. And that's certain even though the flowsheet to be used is almost as much in doubt as is the site for the facility.

CE learns that Standard Uranium Corp. (Moab, Utah) currently is studying the possibility of entering an "arrangement" with U. S. Manganese (jointly owned by Vitro Corp. and Sheer-Korman Assoc.) in which the two firms would build a manganese refinery using USM's high-intensity-arc process (*Chem. Eng.* Dec 29 1958, p. 24) for their flowsheet and Standard's rhodonite concentrate for their feed. But should this arrangement fail to materialize, Standard would use the melting-quenching-leaching process for manganese extraction, newly developed by the Bureau of Mines at Salt Lake City. To date, neither process has been commercialized.

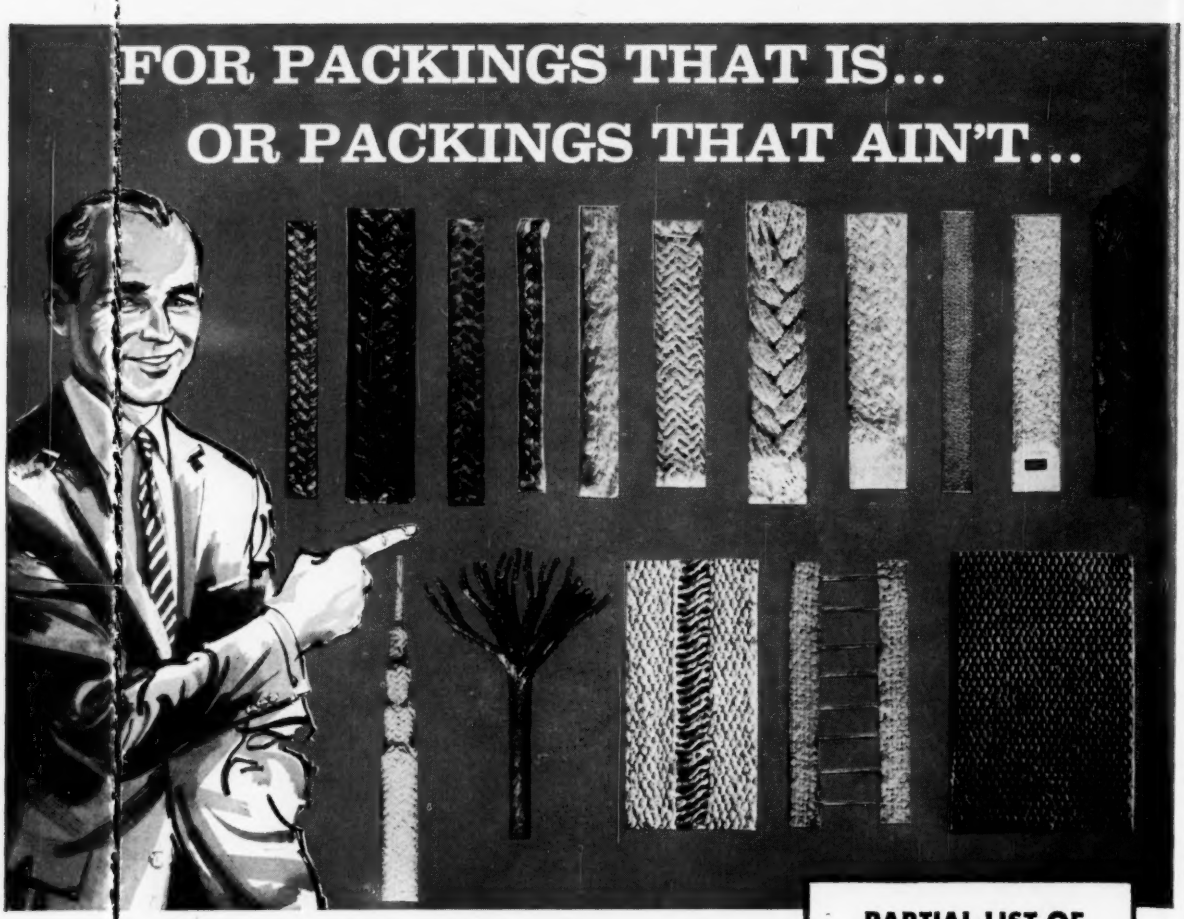
Of the two, USM's process is closest to commercialization whatever the outcome of Standard's study. USM already has declared its intention of scaling up the high-intensity-arc pilot plant it has at Vitro's lab in West Orange, N. J. If it doesn't do it with Standard, USM will go it alone, a company spokesman tells *CE*, using Vitro's reserves of rhodonite ore.

BuMines process also is presently in the pilot plant stage. Process involves melting rhodonite concentrates in a conventional electric-arc furnace, then shock-chilling it with a jet of cold water. Frits are produced out of which manganese can be leached easily with hot, dilute sulfuric acid.

U.S. need: Combat engineer shortage

Declining freshman engineering enrollments; resulting shrinkage of graduating engineering classes; industry's rising demand for engineers (*Chementator*, Jan. 11, p. 35)—to-

FOR PACKINGS THAT IS...
OR PACKINGS THAT AIN'T...



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You name it. The chances are excellent we can furnish you with a top quality packing at competitive prices that "is"—right out of stock. But if you have a particularly tough problem that looks like it might take a "tailor made" packing that just "ain't," let us know. You can bet we'll start working on an answer in a hurry . . . and again you'll get the best, and at the right price.

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PARTIAL LIST OF PACKING AVAILABLE

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- Blue Asbestos Packing—acid resistant
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- Asbestos Gasket Cloth and Sheet Packings
- Asbestos Joint Runners
- Asbestos Double Seal Gasket
- Valve Stem Packings (twisted and braided)
- Asbestos High-Pressure Packing—semi-metallic
- Wrapped Asbestos Packing
- Compressed Asbestos Sheet
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- Interlocking Asbestos Packing
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the packings with "job-specified" design

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DEPT. 254, Bloomington, Illinois

gether these facts are combining to create a national emergency of dangerous proportions, declares the Engineering Manpower Commission.

Recently released figures show a totally unexpected reversal of the seven-year trend (since 1950) of increasing freshman engineering enrollments. In 1958 these enrollments were off over 11%; in 1959, over 3%. Because of this, EMC has been forced to revise its estimates of the number of engineering graduates in the years ahead. Whereas, 1960 should see a bachelor graduating class of some 38,500, by 1963 only 35,500 such degrees are now expected to be granted. Barely a year ago EMC predicted 1963 engineering bachelors would number 46,500. In sharp contrast, the Soviet Union will turn out over 100,000 new engineers annually for the next five years.

To combat this alarming situation, EMC last month proposed a four-point program that would (1) insure that engineers are committed to work challenging their highest level of creative capacity; (2) increase the Federal government's recognition of the vital role engineers play in the nation's future; (3) improve quality of education on all levels and (4) improve the public's understanding of engineers and engineers' functions.

Though these four points spell out much of what must be done, there's a fifth point that's conspicuous by its absence—the question of engineers' salaries. While EMC unaccountably has chosen to ignore this question, it hardly can be a secret that higher salaries would attract more people to the engineering profession and hold those already there. As Du Pont's president Crawford Greenewalt points out in his book, The Uncommon Man (McGraw-Hill), "Of all the motivations to which the human mechanism responds, none has proved so powerful as that of financial gain."

Phos-acid catalyst for ethylbenzene

Solid phosphoric acid has taken another crack at the catalyst job in the alkylation of benzene by ethylene to make ethylbenzene. And this time it looks as if it's going to make a success of it.

Universal Oil Products reveals that its ethylbenzene process on stream at El Paso Natural Gas' 25,800-gal./day plant at Odessa, Tex., uses solid phos-acid catalyst. And after 8 mo. on the line, the plant is working out excellently, declares UOP.

Back in the early '40's, Koppers turned away from the usual ethylbenzene catalyst, aluminum chloride, and made a commercial-scale try in Kobuta, Pa., at using solid phos acid. But, remarks Koppers, "the results were unfavorable" and the project abandoned. Chief trouble: severe corrosion. Koppers now makes its ethylbenzene over aluminum chloride as does virtually every other ethylbenzene maker except, now, El Paso.

UOP apparently whips the corrosion problem with an adaption of its widely used cumene process which employs a solid phos-acid catalyst on Kieselguhr. But, says UOP, a variation on the cumene catalyst had to be developed for use in ethylbenzene making. Though no details are available, the new solid phos-acid catalyst is said to have higher activity to primary alkylation reaction and lower activity to undesirable polymerization side reactions.

Despite a superficial resemblance, El Paso's process, UOP is quick to clarify, is not Alkar (*Chementator*, Apr. 7, 1958, p. 54). Also an ethylbenzene-making process, Alkar feeds on 8-10% propylene-ethylene refinery offgases while this process charges a 30% ethylene-content ethane gas stream obtained from propane cracking. Alkar's catalyst continues to be religiously undisclosed. But in light of the revelation of El Paso's flowsheet, observers now are tempted to speculate that Alkar, too, probably uses a solid phos-acid catalyst.

Computer control: Who's kidding?

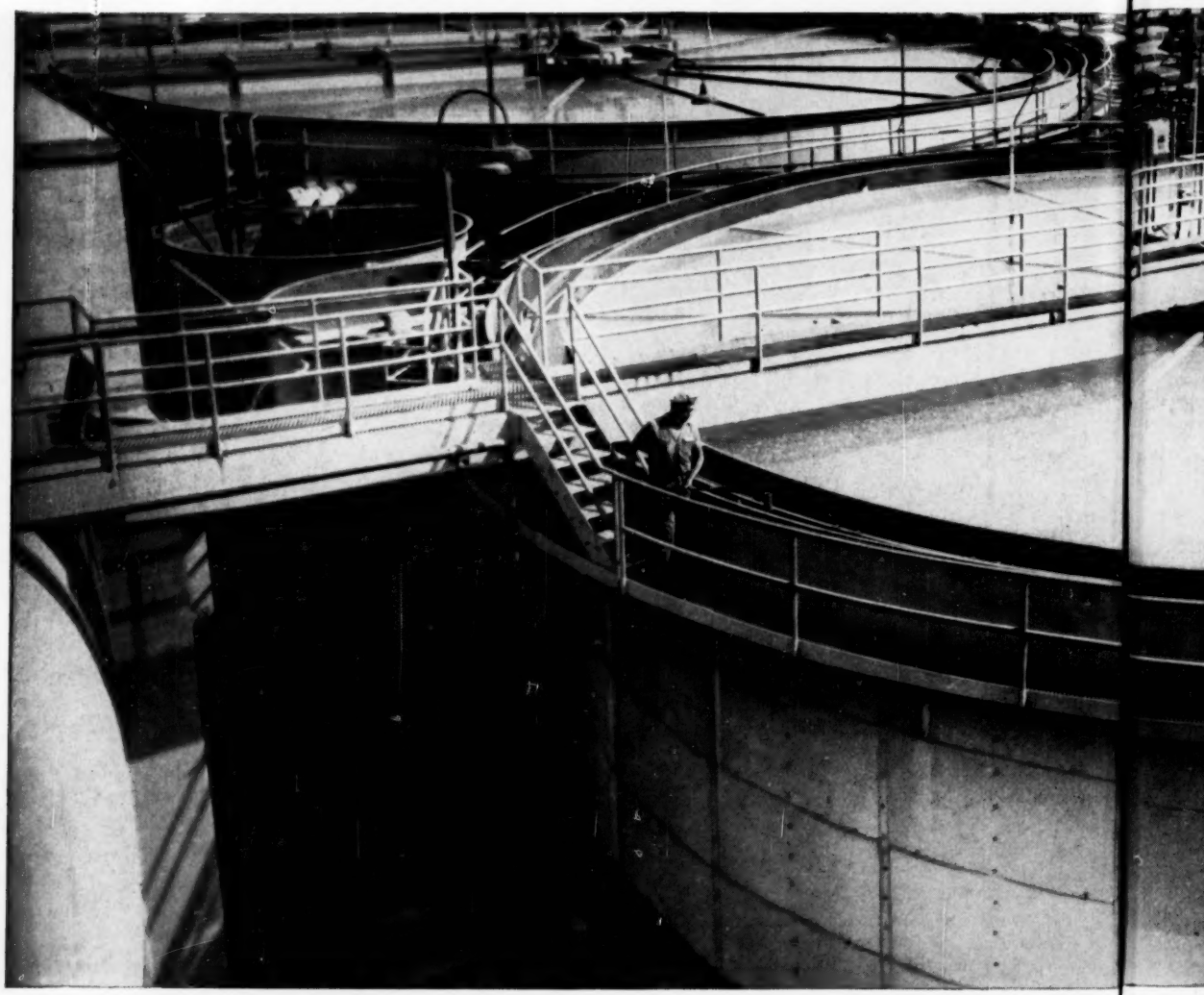
Last month a rash of announcements hit the chemical process industries claiming "firsts" in computer-controlled processes:

- B. F. Goodrich declared it was now operating its Calvert City, Ky., vinyl chloride plant under computer control—the first such system in the CPI.
- Monsanto Chemical declared it had begun startup operations of its Luling, La., ammonia plant under computer control—the first such system in a chemical plant.
- Daystrom, Inc., declared it had just proved the guarantee of 6-mo., 24-hr./day, over-99% on-line time computer operation at Louisiana Power & Light's Sterlington, La., generating station.
- Esso Research & Engineering continues to allow reports claiming that it has the

(Continued on page 58)

At Diamond Alkali Company

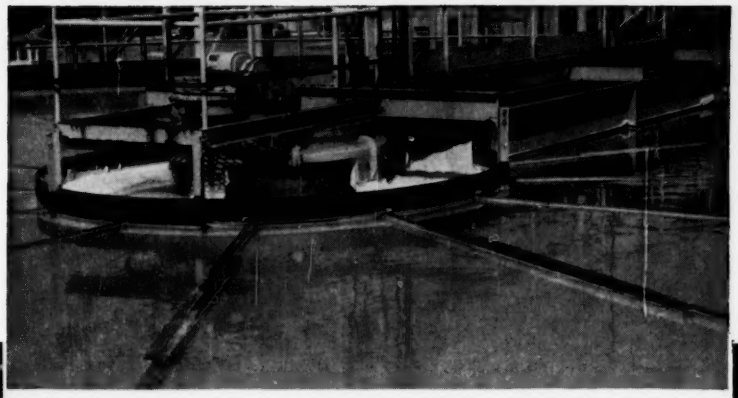
MODERN BRINE TREATMENT PLANT HANDLES LARGE CAPACITY WITH DORR CLARIFIERS



The recently modernized brine treatment plant of the Diamond Alkali Company, at Painesville, Ohio, is one of the largest of its kind in the world. Its design is the result of a coordinated research project carried out by Diamond Alkali's Research Center and Dorr-Oliver's Testing Laboratories at Westport, Conn.

Raw brine from underground wells is stored in a service reservoir, then given pre-treatment with chemicals in Dorr paddle agitators before passing to two 70′ diam. Dorr Clarifiers. The thickened underflow is withdrawn by Dorrco Diaphragm Pumps.

This installation is another example of the adaptability of Dorr-Oliver designs to meet highly specialized requirements. There is a type of Dorr Thickener or Clarifier for virtually every sedimentation or clarification problem in chemical, metallurgical and industrial processing. The long experience of Dorr-Oliver engineers is always at your service to suggest the most effective design and to work out any modifications that may be necessary. Write to Dorr-Oliver Incorporated, Stamford, Conn.—or better still, have one of our engineers call and discuss your particular application.



Close-up of Clarifier influent well (note the contrast between the treated raw brine flowing through the feed channel and the clarified product at the surface of the tank.)

LARGE PHOTO shows the two Dorr Clarifiers in operation. Units are equipped with radial beams and a submerged peripheral launder system.

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"first" computer-controlled pilot plant at Linden, N. J., in operation.

Who's kidding whom?

Goodrich and Monsanto, which have been rushing neck and neck to break their "firsts" ever since the initial announcements last year that they were going to try computer control with Thompson-Ramo-Wooldridge's RW-300, accepted delivery of their computers within days of each other late in '59. But, in point of actual fact, neither company had completed putting its machine in closed-loop computer control at the time of its announcement, and in all likelihood still hasn't. As for Daystrom's statement, the computer at Sterlington was announced to be in operation in the spring of '58—a full 19 mo. prior to the completed 6-mo. guarantee period. And Esso R&E, which stated early in 1958 (*Chementator*, Mar. 10, 1958, p. 74) that it would have the first computer-controlled pilot plant "in a few months," hasn't yet found performance satisfactory enough to accept delivery from Consolidated Electrodynamics.

Much the same thing seems to be happening to computer-control technology as happened to business computers several years back. In a stampede for prestige, companies laid out millions for business computers without proper investigation. And when the machines stood idle, computers suffered a setback that took a couple of years to recoup.

Rayon maker diversifies in fibers

Celanese has acquired world rights to produce and market Darvan, unique nytril fiber developed by B. F. Goodrich. Commercial production of the new product at Pampa, Tex., is expected within a year with an ultimate output of 40 million lb./yr.

Industry observers view this move as the latest evidence of rayon makers' felt need to protect their flanks against the advances of new synthetic fibers. Celanese previously had taken one step in this direction with the formation, with Imperial Chemical Industries, of Fiber Industries to make and market polyester fiber (*Chementator*, Oct. 20, 1958, p. 61). Company expects to start polyester production late this spring in a 40-million-lb./yr. plant in Shelby, N. C.

Other rayon makers in the swelling diversification parade of late include American Viscose into polypropylene (AviSun) and nylon (Chemstrand); Tennessee Eastman into acrylics and polyesters; Beaunit into nylon and polyester; Industrial Rayon into nylon and polypropylene and American Enka into nylon.

In common with these rayon-making colleagues, and most other synthetic-fiber producers for that matter, Celanese believes that it's more profitable to negotiate the complex and competitive fiber distribution channels with a full line. Conversely, like Goodyear, which turned over to Beaunit fiber rights to its polyester, Goodrich has declined to enter the fiber maze with a one-fiber "family."

Goodrich retains rights to non-textile use of Darvan's polymer base, vinylidene dinitrile-vinyl acetate copolymer. Company has done some exploring of film, reports it offers toughness in the order of polyester, high-temperature properties and high transmission of ultra-violet light.

Hybrid rockets join solids to liquids

Resolution of the "best-rocket-propellant" debate may not require a knock-down drag-out fight between solid materials and liquids after all. Recent developments indicate, instead, that the final answer could be provided by exploiting the virtues of each in a rocket-propellant system consisting of both.

Thiokol's Reaction Motors Div. revealed last month that it has been conducting highly promising tests on a rocket engine that burns a *solid* fuel and a *liquid* oxidizer. Earlier, Aerojet General announced that it also has been experimenting with a hybrid rocket.

Goal of this work: To tie the high specific impulse and controllability of liquid systems to the high bulk density and handleability of solids. Idea behind it: Belief that the best oxidizers are liquids, best fuels are solids.

Thanks to use of liquid oxiders, reports RMD, its hybrid engine can be shut off and restarted, and its thrust throttled over full thrust range while in flight. And it delivers specific impulses very nearly in the class of the best completely liquid systems now operational. At the same time, use of solid fuel increases bulk density of propellant, thus makes for more compact engine. And it eliminates complex liquid handling mechanisms, makes for simpler, reliable missile.

Though it's known that propellant system is hypergolic (ignites spontaneously), details of the hybrid engine are closely guarded secrets. RMD decribes the solid fuels that might be involved as "composite types," the

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Reagent, ACS

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HYDROFLUORIC ACID
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liquid oxidizers as "conventional and unconvential, low- and high-density materials." There's some speculation that solid boron fuels may be under investigation.

Sulfur from SO_2 looks promising

Backtracking from sulfur dioxide in smelter gas may seem an illogical way to produce elemental sulfur—except, possibly, in a nicely balanced framework of economic conditions. Texas Gulf Sulfur and International Nickel are confident that they have that nice balance and the technology to make it show a profit. Reason: Encouraging results from an 8-mo. run in a $500,000 joint pilot plant at Inco's smelter at Copper Cliff, Ontario.

Technology involved: A process in which SO_2 in roaster gas is reduced with natural gas (available at Copper Cliff), propane or fuel oil at "moderately" high temperatures over a special, unidentified catalyst. To go with this process, Inco and Texas Gulf have at least three important economical factors:

- Nearness to the Great Lakes sulfur market. It may be possible to bring Copper Cliff sulfur into Chicago, for example, at a price competitive with barged brimstone.
- Inability to market locally all available smelter sulfur as liquid SO_2 and sulfuric acid. It may be a better economic bet to temporarily store sulfur on site for immediate use than to ship SO_2 and H_2SO_4 great distances.
- A partner in Texas Gulf whose business is sulfur. To metal firms with proposed S-from-SO_2 schemes in the past, sulfur marketing has been unwanted and unfamiliar.

Tomorrow's Technology

Today's embryonic developments which have special significance for chemical engineers

New recording technique unveiled

Whether invention of Thermoplastic Recording (TPR) will "rank in importance with the original invention of photography, the phonograph and magnetic recording," as inventor General Electric speculated at TPR's unveiling last month, it's sure to vastly improve information retrieval and data storage.

According to GE, TPR can concentrate 100 times as much information in a given space as can magnetic recording, can produce pictures in black-and-white or color without chemical processing and can be erased and reused as desired. It's conceivable that in a few years, says GE, TPR equipment the size of an office desk will store and retrieve entire libraries of business reports, engineering drawings and technical data. And the implications of such storage densities with regard to computer applications in design or process control are immense.

TPR uses electrons to convert information, including visual images, into microscopic wrinkles in an unidentified plastic. A fine electron beam, modulated by information to be stored, lays down a pattern of charges on the surface of special, fast-moving, three-layer plastic tape. Temporary softening by radio-frequency heater of top layer enables electrostatic forces associated with charges to deform surface. Cooling freezes information-bearing wrinkles, forming a permanent record. An optical diffraction system reproduces information.

Thermoelectricity for a.c., cooling

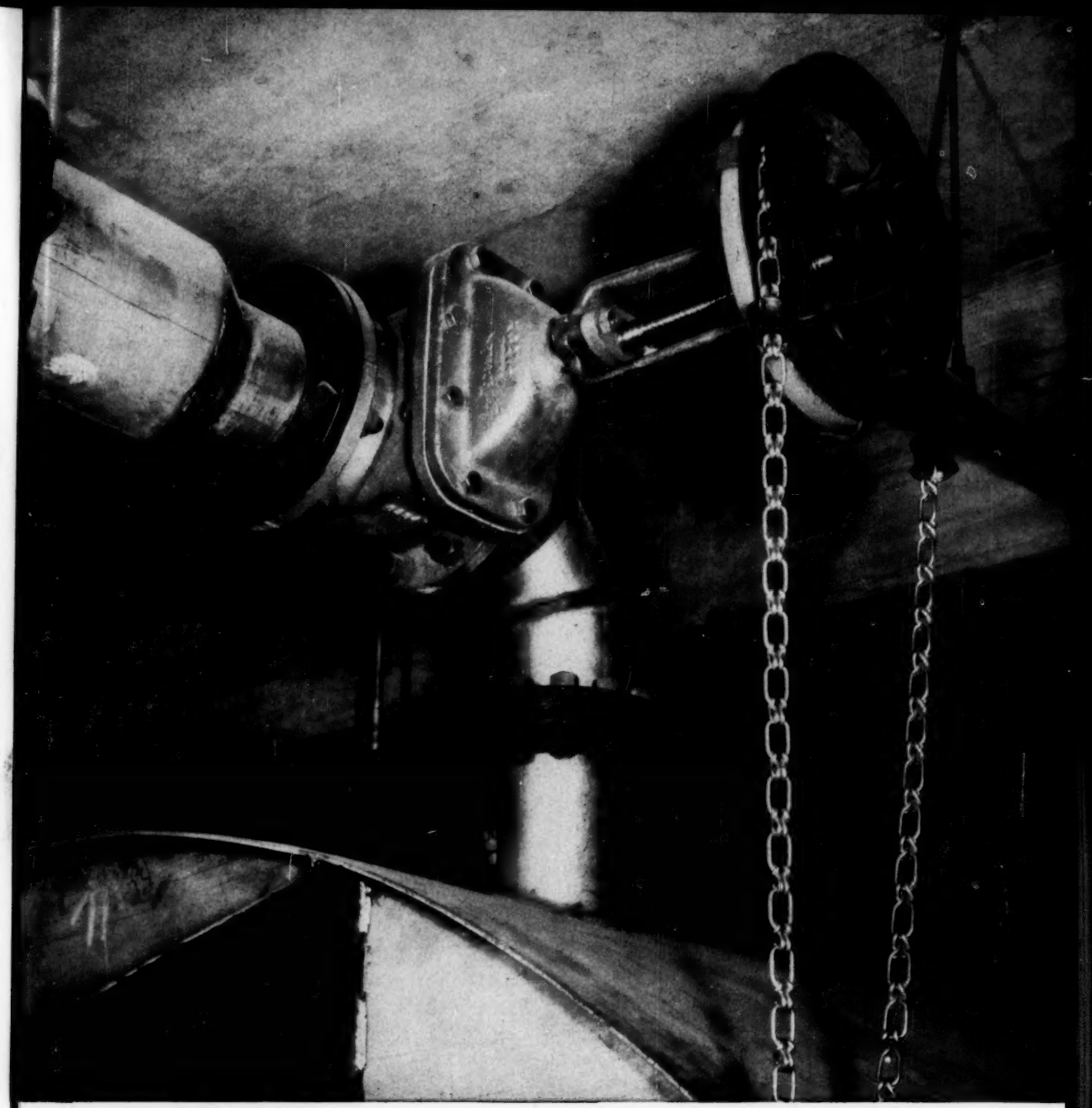
Thermoelectricity keeps cropping up in the news with a regularity that underscores the very real commercial promise as well as the purely scientific fascination this concept holds for researchers. And each time it makes a new appearance, it shows off additional ways it may be put to use. Latest developments come from General Dynamics, Westinghouse and General Electric's English affiliate.

GD, with partial support of nine utilities, has come up with a thermoelectric cesium cell to convert heat directly into alternating current without the use of rotating machinery or d.c.-a.c. converters. Previously, thermoelectric devices produced only d.c. electricity or, at best, only negligible amounts of a.c.

Both GE and Westinghouse have thermoelectric units for use as cooling devices.

GE reports that semiconductor thermocouples of materials such as bismuth selenide and sulfide, lead and antimony tellurides, designed for 5-10 amp. d.c. will provide about 0.25 w. of cooling power. Westinghouse announces a line of commercially available thermoelectric cooling devices. One unit can maintain a 25 C. temperature differential with a heat load of about 17 Btu./hr.

For more on DEVELOPMENTS.....62



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Solar Energy, Fuel Cells Slated to be Teamed

Two "exotic" concepts in power generation—solar energy and fuel cells—are slated to be teamed. Lockheed Missiles and Space Div. of Lockheed Aircraft (Sunnyvale, Calif.) last month was awarded a 12-month, $117,610 contract by the Army Signal Corps to devise a system by which solar energy would be harnessed to the job of running fuel cells.

John P. Nash, Lockheed's research director, explains that the contract calls "for exploratory work on certain systems dealing with regenerative methods of utilizing solar energy and designed to operate continuous fuel cells." Though details of Lockheed's approach to the problem are under the usual tight government security wraps, Nash indicates that photochemical methods of regeneration will be used. A photochemical reactor would absorb sunshine energy, convert it "for use in the fuel cell." Object is to develop a system in which fuel cell would operate without the consumption of fuel or chemicals.

Thermoelectric Generator Put on Sale by U.K. Firm

What's described as the world's first commercial thermoelectric generator is now being put up for sale worldwide by a British firm. International Technical Developments Co., Colnbrook, Bucks, England, reports that it has started marketing for $56 (fob. United Kingdom) a thermoelectric device that's capable of generating 2 to 3 watts of power and enough d.c. current to operate a portable radio.

Unit was developed by the Leningrad Institute in the Soviet Union where it has been in commercial production for the last two years. It consists of a zinc antimonide thermocouple which can be activated to produce electricity by an extremely weak, low-intensity heat source. The British firm, which acquired manufacturing and marketing rights to the device from the Russians last month, claims that as weak a heat source as a paraffin lamp can be used. As a result, the generator can provide electric current for regions isolated from the usual power sources. Recently, Westinghouse demonstrated an experimental model of a similar device.

New Engineering-Unit Prefixes Named

For an age in which engineers must deal with numbers that soar to astronomical proportions and diminish to the threshold of the infinitesimal, National Bureau of Standards has adopted a new, expanded set of engineering-unit prefixes to express virtually every practically encounterable multiple or sub-multiple.

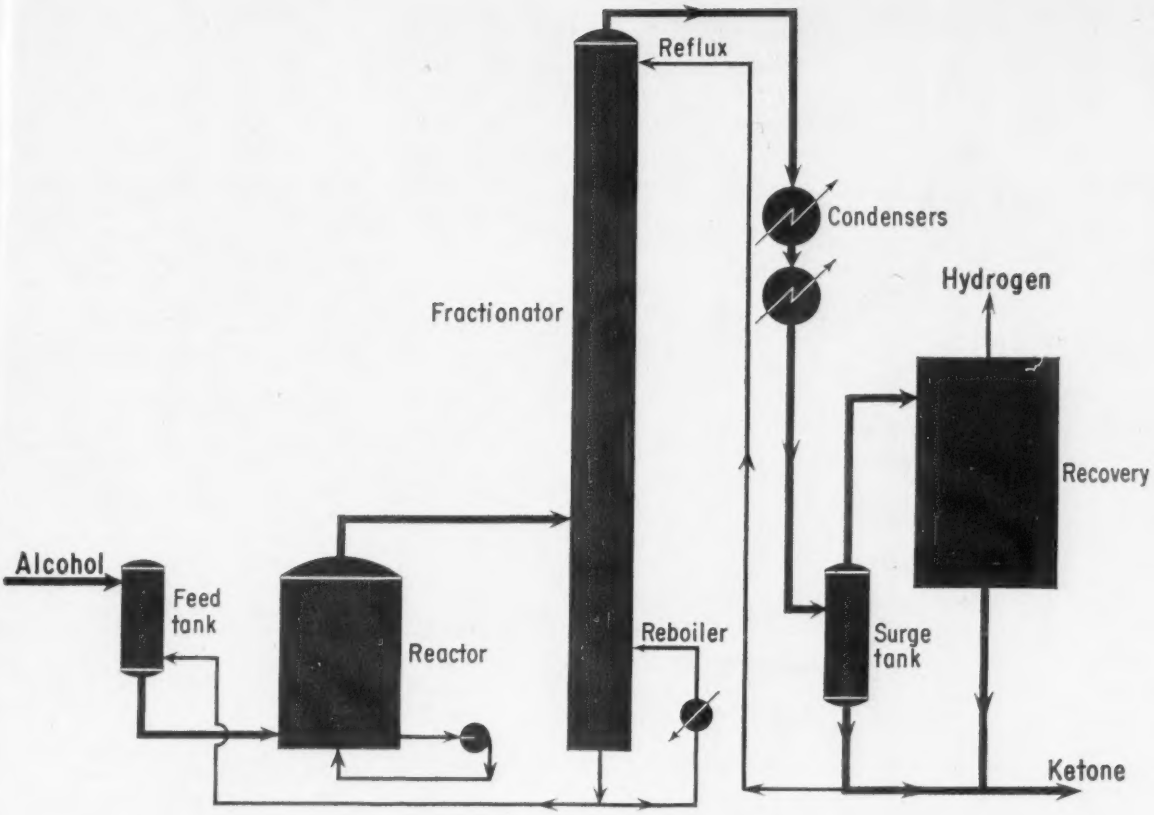
New prefix set—shown in the table below—was originally proposed by the International Committee on Weights and Measures at its Paris meeting in the fall of 1958, was adopted by NBS last month. It includes the eight prefixes long in common use—e.g., mega for one million, kilo for 1,000, etc.—plus four new prefixes. They are: tera for one trillion, giga for one billion, nano for 10^{-9} and pico for 10^{-12}. Thus, for example, one trillion tons now can be expressed as one teraton by the same rules that permit one million tons being expressed as one megaton.

Multiples and Sub-Multiples	Prefixes	Symbols
$1\,000\,000\,000\,000 = 10^{12}$	tera	T
$1\,000\,000\,000 = 10^{9}$	giga	G
$1\,000\,000 = 10^{6}$	mega	M
$1\,000 = 10^{3}$	kilo	k
$100 = 10^{2}$	hecto	h
$10 = 10$	deka	dk
$0.1 = 10^{-1}$	deci	d
$0.01 = 10^{-2}$	centi	c
$0.001 = 10^{-3}$	milli	m
$0.000\,001 = 10^{-6}$	micro	u
$0.000\,000\,001 = 10^{-9}$	nano	n
$0.000\,000\,000\,001 = 10^{-12}$	pico	p

Machine in Russia May Displace Chemist

Soviet scientists are trying to develop a "chemistry information machine" to choose best-suited compounds for a desired reaction. Machine would "look over" functional groups of molecules to choose the best compound from millions of possible ones, according to Soviet news agency, Tass.

Along parallel lines, other Russian scientists are working at representing chemical structure by linear mathematical ciphers. They are developing a machine to cipher, without the help of chemists, formulas of chemical compounds. After ciphering formulas, machine can also retrieve ciphered formulas from storage for deciphering.



Liquid Phase Works for Dehydrogenation

Secondary alcohols yield ketones in catalytic liquid process that costs less to install, works at moderate temperatures.

A repeat order from the first user now stamps the IFP ketone process as an established commercial process. Satisfied with four years output from its initial 1,000-ton (metric)/yr. plant at Palencia, Spain, the Bioquemica company has added a new 5,000-ton/yr. IFP unit, scheduled for startup early in 1960.

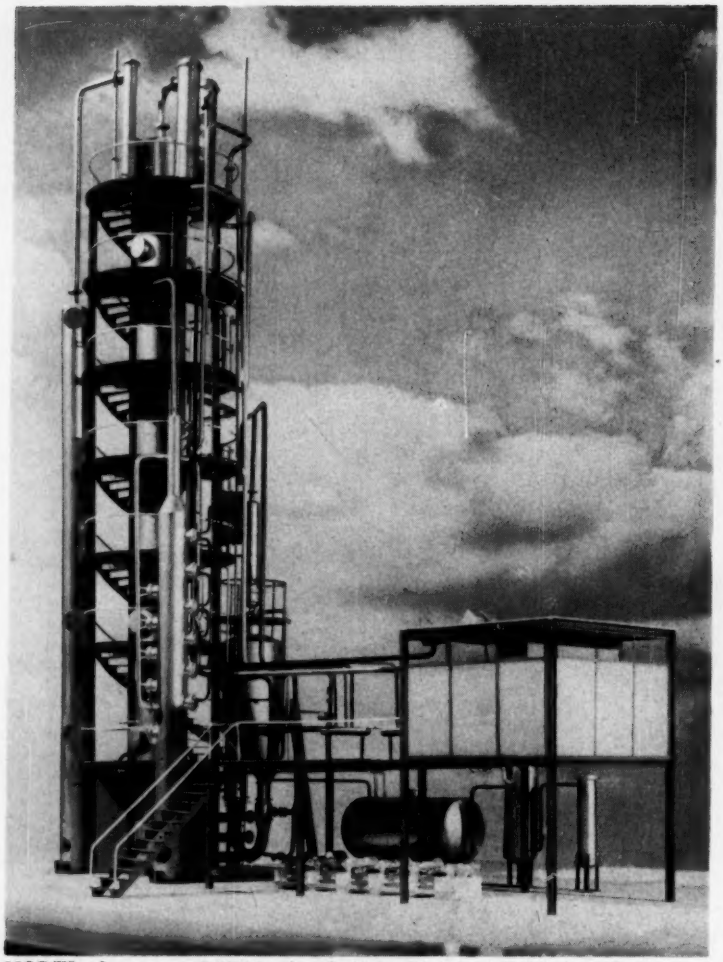
Developed at Institut Francais du Petrole (Paris), the IFP process (U. S. 2,829,165) converts most secondary alcohols, aliphatic or cyclic, anhydrous or hydrated, into the corresponding ketones through a continuous catalytic liquid-phase reaction.

So flexible is the process that the same plant can process isopropyl and secondary butyl alcohols alternately without shutting down the unit. However, Bioquemica intends to use its new unit mostly for producing acetone, the old one for methyl ethyl ketone (MEK).

▶**Why Use Liquid Phase?**—By selecting the IFP process, Bioquemica can produce ketones while operating with temperatures in the 300-F. range rather than the 600-900-F. level required for vapor-phase processes. According to IFP, the low-temperature, liquid-phase procedure increases yield approximately 3% to 99.5% for aliphatic ketones and 95% for cyclic ketones.

Apparently, IFP can reach this performance level with a lower capital investment than needed for other processes. Estimated cost of a 10,000-ton/yr. plant to make acetone from azeotropic mixture of isopropanol and water is $287,000, not including storage facilities.

From an operating stand-



MODEL shows new 5,000-ton/yr. ketone plant just finished in Spain.

point, the IFP process is reported to offer simplicity. There is no need for auxiliary feed preparation or product purification, other than separation of hydrogen and recycle stream. Catalyst has been found to remain active after more than two years of continuous on-stream service.

By operating at lower temperatures, the IFP process reduces utility requirements by one third.

▶**Cooler in Liquid**—Reasoning behind IFP's liquid-phase reaction is that liquid provides the environment needed to displace favorably the reaction equilibrium.

For its reaction medium, IFP uses a high-boiling solvent containing suspended finely divided Raney nickel or copper chromite catalyst. Selected from saturated paraffinic or naphthenic hydrocarbons, this solvent does not vaporize at the reaction temperature nor react with the byproduct hydrogen.

In operation, this medium is held somewhat above the boiling point of the product ketone. Thus, ketone and hydrogen are driven off as soon as they form by dehydrogenation of the alcohol feed.

By this rapid removal of products, process speeds up reaction and makes possible completion of the reaction at relatively low temperatures.

▶**No Side Reactions**—Handling anhydrous feed, the IFP process operates at atmospheric pressure and, usually, at a temperature of 300 F. When the feed contains water, pressures can be varied to deal with the problem of azeotropes during distillation.

Fed into the agitated, steam-heated reactor, the alcohol is converted directly to ketone without formation of undesirable side products. Effluent vapors of ketone, unreacted alcohol and water together with hydrogen and entrained solvent, flow into packed column for rectification.

Typical concentrations of ketone, related to total weight of ketone and alcohol in effluent, range from 31% for acetone to 24% for cyclohexanone.

Bottoms from column, containing solvent and alcohol, return to reactor feed tank. Ketone and hydrogen go overhead.

▶**Simple Recovery**—Mixture of ketone and hydrogen passes through two condensers in series against 70-F. water. Ketone condensate goes to storage after splitting off a side stream for reflux.

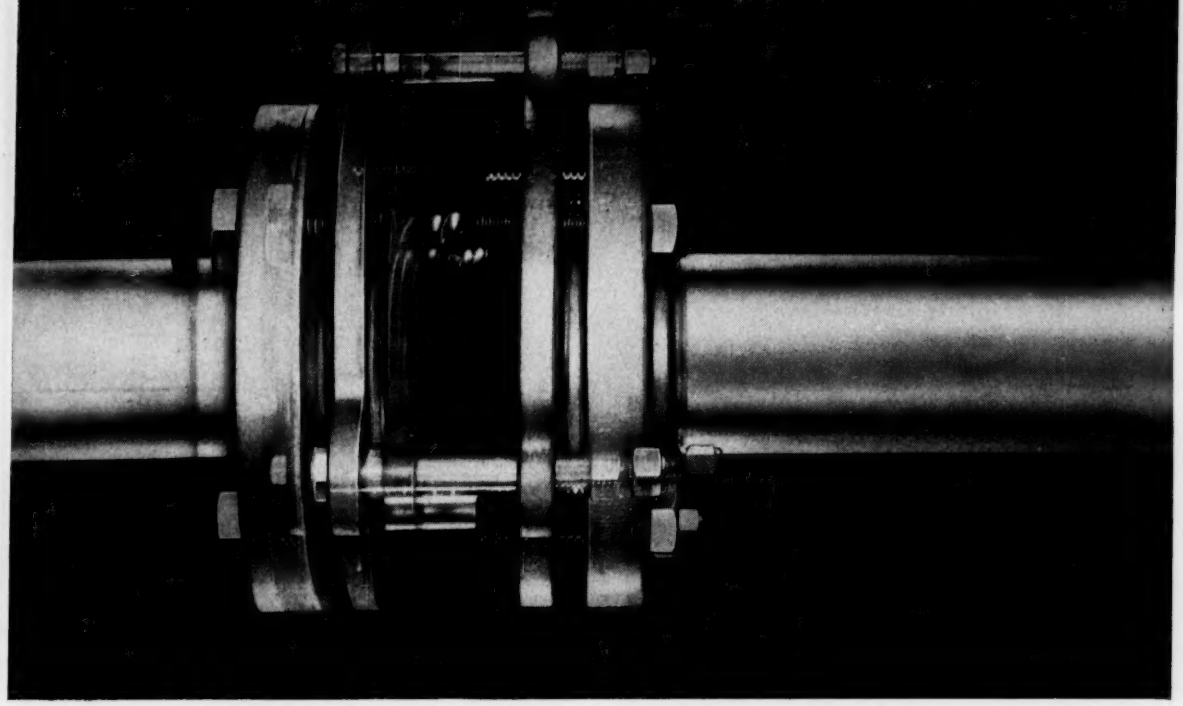
When the product is either methyl ethyl ketone or acetone, hydrogen leaving the condenser carries appreciable quantities of the ketone. To recover MEK, the gas is compressed and passed into a liquid ammonia coolant. Acetone, on the other hand, is washed out of the hydrogen by counterflowing water and recovered by atmospheric distillation.

If the process is set up to manufacture cyclohexanone, hydrogen coming from the condenser contains practically no ketone.

Ketone products are reported able to satisfy customer specifications. Byproduct hydrogen is free of noncondensables and suitable for hydrogenation reactions.

Processes & Technology continues on page 66.

Is pipe VIBRATION your problem?



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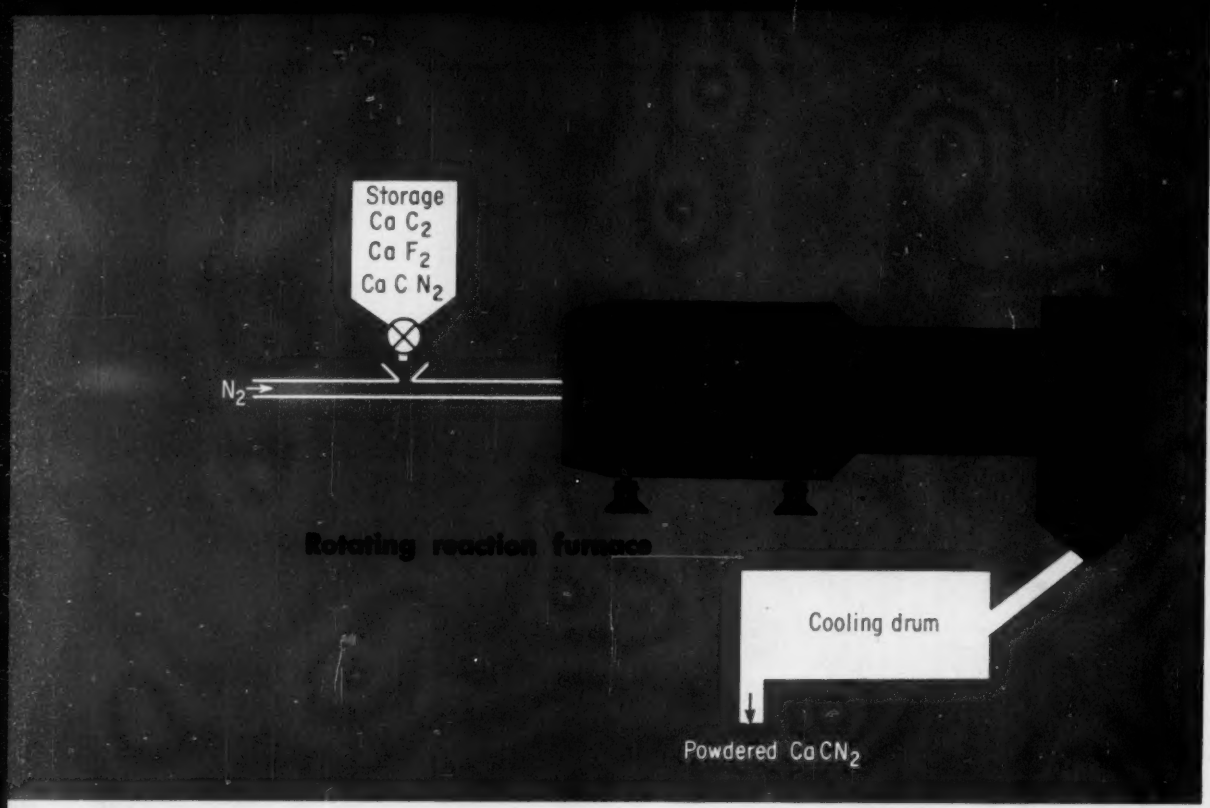

Finer Feed Improves Nitrogenation

By curbing fusion of solids in hot reaction zone, process can use a finer range of feed particles to gain efficiency.

Calcium cyanamide, an important agricultural chemical and starting point for cyanamide derivatives, has been getting a big play in Germany recently. Just a few months ago, Sueddeutsche Kalksticktoff-Werke A.G. (Trostberg, Bavaria) released operation details of their radical, but economical, 48-tons/day (24% fixed N_2) rotating-furnace process.

And now, up-to-date information from this same firm tells of the imminent startup of another, 104-tons/day process that would combine the rotating furnace with a preliminary fluidized-bed reaction step. Particulars of the fluidized-bed step within the larger plant are obscure; its use in the setup reportedly awaits pending licensing negotiations.

▶**Key Factor: Particle Size**—Like many conventional cyanamide processes, the product-producing reaction of the Sueddeutsche process is exothermic nitrogenation of calcium carbide.

$$CaC_2 + N_2 \rightarrow CaCN_2 + C + 72{,}000 \text{ cal.}$$

Unlike conventional processes, the rotating-furnace technique utilizes a finely powdered carbide feed (less than 0.2 mm. particle size).

Since the nitrogenation is a surface reaction, process efficiency is inversely proportional to particle size. Economics of the Sueddeutsche process, then, are logically very favorable, as indicated by data on p. 68.

Actually, fines in the carbide feed to conventional rotary kilns are highly undesirable. At the high operating temperatures involved, any fines present tend to fuse to form lumps that do not nitrify readily. In the Sueddeutsch process, however, some calcium cyanamide product is recycled to the feed stream; this trick stops sintering, and also prevents reversal of the nitrogenation reaction.

▶**Furnace Design, Operation**—Sueddeutsche's furnace, developed in cooperation with Maschinenfabrik Fellner & Ziegler (Frankfurt), rotates on a horizontal axis. It thus looks somewhat like a conventional rotary kiln, though considerably smaller. In contrast to a rotary kiln, the furnace's front end is

THE ORBIT OF ACCEPTANCE . . .

It's still young enough to be called "new" . . . but the MIKRO-PULSAIRE is actually a veteran that's proving itself all over the world on virtually every type of product recovery and nuisance dust collection job. If you're looking for assurance of around-the-clock recovery, full-time automatic cleaning and absolute minimum maintenance, you'll find it in the MIKRO-PULSAIRE. It's a completely simplified unit, as the basic components illustrated above will show you . . . and yet it delivers a filtering efficiency of 99.9% plus, on a wide variety of dusts. Engineered for economy, the exclusive Mikro jet-action principle eliminates gears, cams, chains and other high replacement-cost parts inside the cabinet, and guarantees longer bag life, as well. There's a MIKRO-PULSAIRE for every collection job, including new modular construction units with capacities to any known requirement. Write for Bulletin 52A!

PROCESSING SYSTEMS

MIKRO-Products

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Pulverizing Machinery Division • Metals Disintegrating Company, Inc.
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REPRESENTATIVES throughout the United States, Continental Europe, British Isles, Canada, Mexico, Central and South America, West Indies, South Africa, India, Japan, Philippines, Australia and New Zealand.

MANUFACTURING FACILITIES: United States, Canada, Continental Europe, British Isles,

With Finer Feed, Sueddeutsche Outperforms Rivals

	Conventional Rotary Kiln	Sueddeutsche Process
Reactant particle size, mm.	0.3–2.0	0.2
Calcium carbide, tons	3.16	2.92
Nitrogen, cu. ft.	163	100
Fluorspar, lb.	61,000	43,300
Power input, kwh.	318	227
Labor, man hr.	12.7	1.8

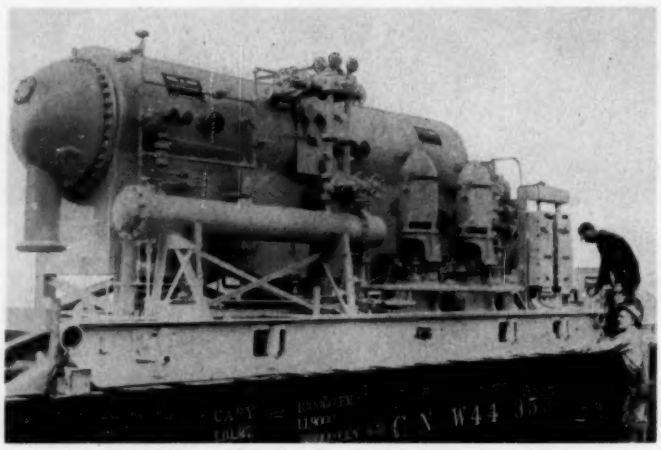
Basis: 1 ton of fixed N_2 in $CaCN_2$ product.

enlarged to form a reaction chamber of 8.6 ft. inner diameter and 10 ft. in length.

Suspended in a stream of nitrogen, the pulverized feed mixture of calcium carbide, calcium cyanamide and fluorspar blows into the head of the furnace. Nitrogenation occurs within the first 10 ft. of travel only, at temperatures of 1,930 to 2,120 F.; these temperatures are maintained by the reaction.

Product moves out of the end of the furnace, and falls into a cooling shaft leading to a cooling drum. In this drum, product temperature drops to 127 F. Resulting calcium cyanamide product (with carbon and mineral impurities) is fine-grained, and requires no further crushing. Its nitrogen content is 24%; carbide content runs 0.03-0.05%.

Proportion of recycle cyanamide in the feed stream depends on the quality of feed carbide. Fluorspar, comprising about 2% of the feed, acts as a flux to lower reaction temperature without affecting rate.



For Arctic, Condenser Needs Antifreeze

Specially built for underground operation in the Arctic, this condenser for Army nuclear power plant had to meet a 15-ton weight limit for air transport, needs special condenser fluids for extreme low-temperature surroundings. Made by Worthington Corp., Harrison, N. J., 29,100-lb. condenser has aluminum tubes, uses an ethylene glycol-water solution that won't freeze until its temperature reaches —55 F. Skid-mounted power plant is portable, can be relocated, as needed.

Plastics Seek Rocket Casing, Jet Engine Jobs

Plastics, already the darling of missile-component makers, are beginning to seek and find some even more basic jobs in the high-flying space age. First scores: As rocket casings and jet engine compressor housings.

Zenith Plastics (Gardena, Calif.), a subsidiary of Minnesota Mining and Manufacturing, reports that it has fabricated and tested a demonstration model of a rocket-motor casing made out of 3M's Scotchply reinforced epoxy resin. And Westinghouse announces that it has built and operated at Kansas City, Mo., a full-scale jet engine compressor housing of reinforced polyester.

Standout features of Zenith's plastic rocket casing are light weight, high strength, low cost and ease of fabrication. Company claims model's strength-to-weight ratio is over 1 million in. and this figure could be upped at least 25% with refinements in fabricating methods. This means rocket motor constructed of plastic would be 25% lighter than one made of steel with equal strength, declares Zenith. Cost of unit is put at 35% less than similar steel casings. Furthermore, plastic construction removes size barriers imposed by conventional fabrication techniques, and solves problems of joining and closures.

Westinghouse's plastic jet engine compressor housing has operated successfully in test for over 150 hours (the airborne equivalent of 75,000 miles), has demonstrated distinct advantages over units made of the usual aluminum or magnesium alloys or sheet steel. Among them: lighter weight, lower cost, greater corrosion resistance and ease of manufacture.

Processes & Technology continues on page 70.

YORK Multi-Stage Turbomaster Ideal For Applications Down To 800 cfm

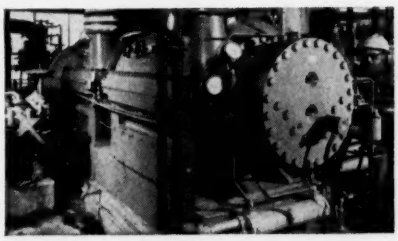
—Offers greater efficiency even for small loads

COMPACT AND ECONOMICAL—On small jobs, Turbomasters offer smoother, pulsation-free operation with virtually no maintenance. On big jobs, two small units can be used, rather than one large machine, to "spare" the system economically.

PRE-ROTATION VANE CAPACITY CONTROL—Standard on all Turbomasters, these vanes provide automatic, continuously variable capacity. This means that compressor capacity stays in direct proportion to load for high system efficiency.

OPERATE BELOW CRITICAL SPEED—Turbomasters up to 6 stages operate well below critical speed. Short, stiff shaft and lightweight aluminum rotors make this possible. Impeller assembly factory-tested at an over speed of 20% or more to insure reliability.

VERSATILE TO MEET YOUR REQUIREMENTS—Up to 8 stages in one casing with choice of casing and rotor materials and sizes, plus side loading and interstage connections to meet exacting requirements. Simple centrifugal design has 400 less parts.



Another YORK Trail Blazer Concept Proved In Action at *Wyandotte Chemicals Co., Geismar, La.*—Two 6-stage 1880 hp turbine driven tandem compressors supply refrigeration for chlorine production. Five suction connections handle 2 loads of condensing chlorine at 2 temperature levels, a water cooling load and 2 stages of refrigerant cooling.

YORK

YORK CORP., SUBSIDIARY OF BORG-WARNER CORP., 4502 SOUTH GRANTLEY RD., YORK, PA.

YORK BW DIVISION

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RESEARCH & ENGINEERING
MAKE IT BETTER

Air Conditioning, Heating, Refrigeration and Ice-Making Equipment • Products for Home, Commercial and Industrial Applications

INTO earth goes 23-mi. chemical pipeline that will not freeze in winter.

No Frost in New Chemical Line

Design for new 23-mi. benzene pipeline protects against freezing during severe Michigan winter.

Benzene freezes at 42 F. But even severe winter temperatures will not freeze it inside a new pipeline linking Dow Chemical Co. storage tanks at Bay City, Mich., with Midland plant 23 mi. away.

That's the confident opinion of Dow engineers who mastered a knotty problem in unsteady-state heat losses to arrive at final design of the pipeline. Verification of this opinion awaits operation of pipeline for 12 mo. following startup now scheduled tentatively for spring 1960.

▶ **Striking a Balance**—Basically, Dow's problem is to preheat the benzene and hold down heat losses sufficiently from the 23-mi. pipeline so that the liquid will not freeze before discharging at Midland, even under the worst combination of circumstances.

To resolve this problem, Dow engineers first determined minimum ground temperatures at pipe-laying depths. Then, working with pipe sized to handle maximum flow, they had to establish optimum pipe-laying depth, insulation specifications and benzene entrance temperature to assure freedom from freezing at minimum flow rate.

To handle peak flows, Dow selected a pipeline with 4.5-in. O.D. Laid at 4-ft. depth, this line is exposed to minimum soil temperature of 32 F. during the most severe above-ground winter temperatures. For about five months — December through April—ground temperature will stay below benzene's freezing point.

▶ **Protect With Foam**—To hold heat loss in check under these temperature conditions and with flow rates varying widely, Dow installed 3-in. polystyrene-foam insulation over undercoating of wax and layer of saran film.

With this amount of insulation, benzene entering line at 140 F. should reach Midland no cooler than 43.6 F. under the worst conditions. And even entering at 140 F., the benzene is still not hot enough to soften, melt or degrade either the wax or polystyrene.

▶ **Pilot Project**—As a producer of polystyrene beads, Dow set up temporary facilities in Midland to mold nearly ¼ million feet of polystyrene-foam insulation in tubular half sections, 9-ft. long and 3-in. thick. Classed as experimental, these manufacturing facilities enabled Dow to evaluate techniques for making this type of insulation.

Insulation from these facilities was installed on the pipeline in staggered pattern, to keep ends of the tubular half sections from coinciding. Lengths of wire, twisted around the sections hold them on pipe.

New Technique Probes Radical Reactions

Bureau of Standards has come up with a new technique for studying low-activation-energy radical-molecule reactions. Importance of low-activation-energy systems in general is that they're of great interest in basic studies of mechanisms and kinetics of certain elementary chemical reactions.

Until recently, low-activation-energy reactions such as radical-radical, radical-molecule, ion-ion and ion-molecule have been ex-

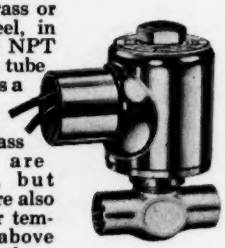
OK Flow Sheet

HOKE REPORTS ON FLUID CONTROL

A VALVE NAMED "DESIRE"

With apologies to Tennessee Williams, we really have produced a Solenoid Valve line based on *your* desires. We surveyed all the solenoid valve users we could find to determine what *you* wanted. The result is Hoke's "User Designed" Series 90 and 95, two-way and three-way, direct-acting solenoid valve line.

Thanks to you, we have much to brag about. Here's what we have been saying about these new valves: lightest weight – smallest size – no-hum operation – lowest temperature rise – lowest power consumption – stainless steel plunger – silver AC shading coils – easiest installation – packless construction – 360° rotatable housing – operates in any position.



We make them of forged brass or stainless steel, in ⅛" and ¼" NPT size or JIC tube ends. There's a variety of AC and DC voltages. Class "A" coils are standard, but Class "H" are also available for temperatures above 212°F. For those with high insurance rates, we can supply explosion proof coil housings.

Now that we've bragged a bit, we must also apologize for our premature enthusiasm. We were so excited about this product that we stirred up a hornet's nest of interest before we were ready to deliver in quantity. Shipments were slow at the start, but now we can have any reasonable quantity of these "desirable" solenoid valves "on-stream" in your plant when you want them.

There's only one way to get conclusive performance proof – buy a valve. Ask for Bulletin SV-1159.

What Goes With What?

This is a question engineers and chemists are constantly asking each other. Not that we want to do away with this healthy interplay at the water cooler, but we have put together a slide rule that answers all these questions. It lists 22 metals and materials and their degree of resistance to 247 corrosive agents.

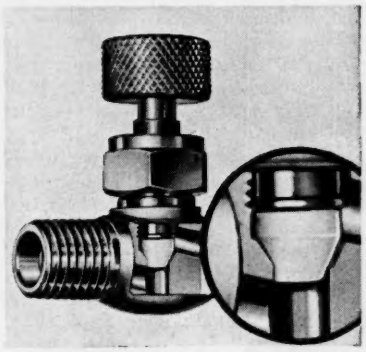
Got yours? Write now while there are a few (thousand) left.

HOKE'S NEW PLASTIC STEM TIPS END CHRONIC FAILURE PROBLEM

Galling and scoring valve seats plagued valve users and manufacturers for years, until somebody thought of using plastic stem points. This idea worked well at low pressures, but when the pressure increased – poof! – the valve blew its tip. Up to now, this problem had continued to bother valve makers.

Fortunately, a die-hard Hoke engineer insisted he could put a permanent plastic tip on a high pressure valve. We gave him his head and he gave us a plastic-tipped valve-stem (using either Kel-F or Nylon). His unique design incorporates a crimped metal shell that grabs the plastic tip and *really* holds!

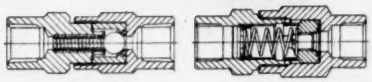
Not satisfied with this monumental accomplishment, he proceeded to tackle leak problems at the stem packing. He put an O-ring seal on the stem and compressed it with a newly-designed Nylon collar. The collar serves a dual role, for it also prevents grit and other foreign matter from chewing up the O-ring. Valves of this new design have performed successfully up to 3500 psi. Our die-hard engineer not only



ended galling, but also seat leakage, stem leakage and wear problems – all at one swoop.

There's only one feature about this new development that worries us–since we do not expect replacements we may have designed ourselves right out of the valve business! We make these little dandies of either forged brass, bar stock or 316 Stainless, with ⅛" and ¼" male connections. Temperature limit is 400°F. For the complete story, write, wire, phone or we'll come see you.

Hoke "TECH-SPEC"



BALL TYPE PISTON TYPE

570 SERIES CHECK VALVES

Designed for gas or liquid service at pressures to 5000 psi. Ball and piston types for extremely effective leak-tight closure, coupled with minimum flow resistance. Ball types in ⅛" and ¼" sizes; piston types in ⅜" and ½" sizes. Temperature limits, –40 to 200°F. Body materials are Brass or 303SS. End construction is interchangeable with any combination of inlet and outlet connections. O-ring seals are available.

HOKE, INCORPORATED
39 Piermont Road, Cresskill, N. J.

Send me complete information on the Hoke products checked below:

- ☐ Plastic Stem Tips
- ☐ Solenoid Valves
- ☐ 570 Series Check Valves
- ☐ FREE Corrosion Slide Rule
- ☐ Have a salesman call

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tremely difficult to set up. Bureau's studies now provide a simple method of exploring radical-molecule reactions at liquid-nitrogen temperatures.

In producing such a reaction, radical is prepared in the gas phase and then made to diffuse into a solid capable of reacting with it. By this technique, Bureau found, for example, that hydrogen atoms can diffuse into solid olefins, and react with some (such as ethylene, propylene, butene-1) at 77 K., with others at slightly higher temperatures. Bureau found, also, that hydrogen atoms react with solid oxygen at 20 K., with halogens at temperatures as low as 77 K., and with certain aromatics such as toluene or styrene and its derivatives at 77 K.

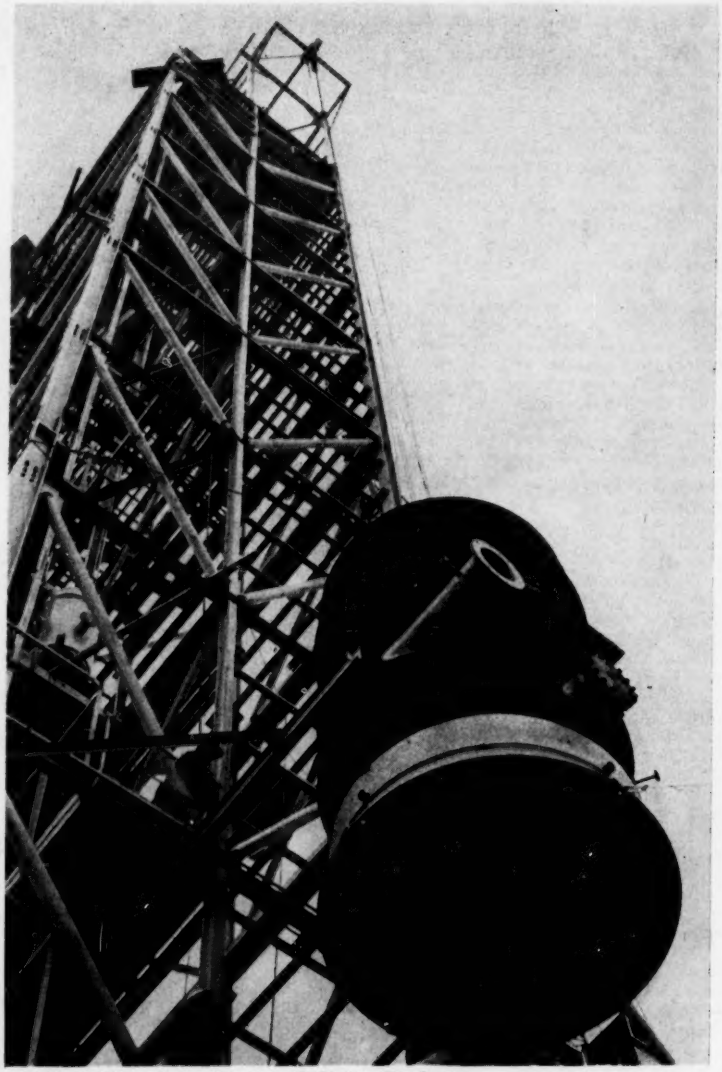
Here's the Bureau's experimental technique. Olefin such as butene-1 is uniformly deposited as a thin film on the inner surface of a spherical bulb immersed in refrigerant. Molecular hydrogen is introduced until pressure reaches about 100 microns and dissociates on the heated filament. In a time as short as 5 sec, depending on filament temperature, reaction takes place between olefin and hydrogen atoms. Rate of reaction is proportional to pressure drop of hydrogen. Reaction products can be analyzed by infrared techniques or, after warmup, by gas chromatography and mass spectrometry.

Foreign Fatty Acid Plant Will Use Ozone Splitting

A new plant to be built northeast of Rotterdam, Holland, will use ozone splitting of fatty acids to make chemicals for plastics, synthetic lubricants and lacquer and paint industries. Plant will be jointly owned by Unilever N. V. of Rotterdam and Emery Industries, Cincinnati, Ohio.

Recently, Emery broke ground for its $6-million ozone-oxidation plant at Cincinnati which will produce azelaic and pelargonic acids by ozone-oxidation route (*Chem. Eng.*, Nov. 2, 1955, p. 32).

INDUSTRY NEWS



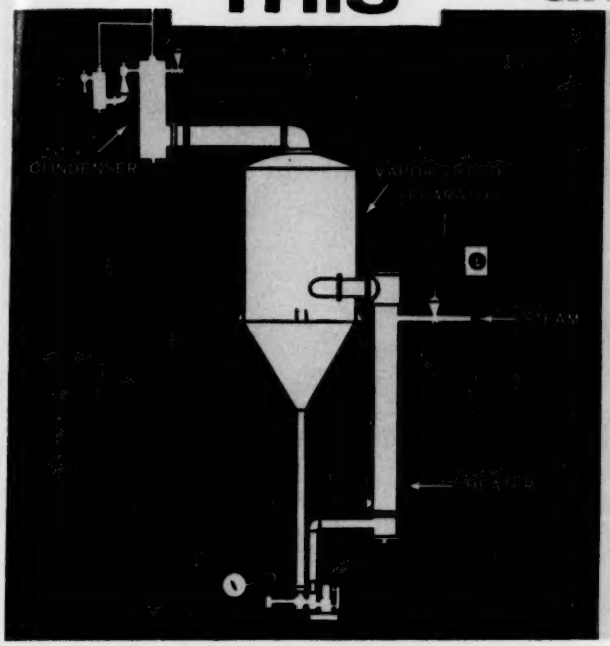
UREA Prilling Tower Soon to Pelletize Product.

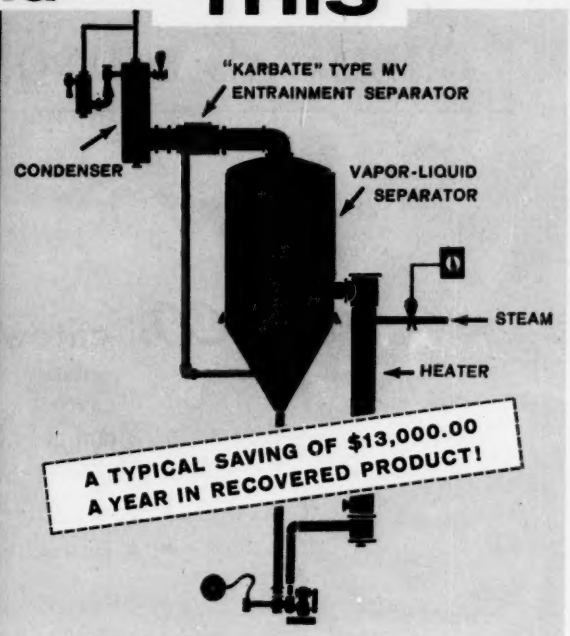
SunOlin, a joint venture of Sun Oil Co. and Olin Mathieson Chemical Corp., is nearing completion of its new urea plant at North Claymont, Del. As one of the final stages of construction, the vacuum separator is hoisted 180 ft. to the top of the prilling tower. New plant, scheduled to go on stream early this year, contributes to the present boom on urea plant construction (*Chem. Eng.*, Oct. 5, 1959, pp. 58–60).

Esso Standard Oil Co. announces plans for a $16-million expansion of its Baton Rouge refinery to increase butyl-rubber output by 38,000

Industry News continues on page 162.

THE DIFFERENCE BETWEEN THIS and THIS





is a corrosion-resistant

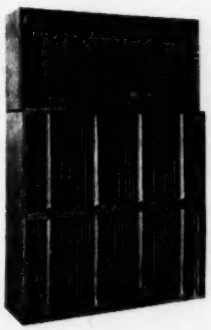
"KARBATE" IMPERVIOUS GRAPHITE TYPE MV ENTRAINMENT SEPARATOR!

The difference between no separator and an efficient "Karbate" entrainment separator on an evaporator is *increased profit and reduced condensate contamination.* A very small product loss in the overhead vapors from an evaporator—even when handling low cost chemicals—adds up to a substantial amount in a year.

For example, a one percent loss of P_2O_5, valued at four cents a pound, is not considered unusual for a phosphoric acid evaporator. An evaporator operating 7,000 hours per year and handling three tons per hour of P_2O_5 will lose roughly $16,800 per year. A large part of this loss can be recovered with a "Karbate" impervious graphite Type MV entrainment separator, paying-out the cost of this equipment — $4,000 including a lead lined transition section or $2,500 with a rubber lined transition section — in a very short period.

In addition to low cost, "Karbate" impervious graphite Type MV entrainment separators offer these features: complete corrosion resistance... high operating efficiency...low pressure drop... simple construction—easily cleaned. For details, write for CATALOG SECTION S-6900.

"Karbate" Entrainment Separator **(Line Type)** View from downstream end showing collector.



"Karbate" Entrainment Separator **(Module Type)** Downstream view of assembly of 12 modules with side plates.

UNION CARBIDE

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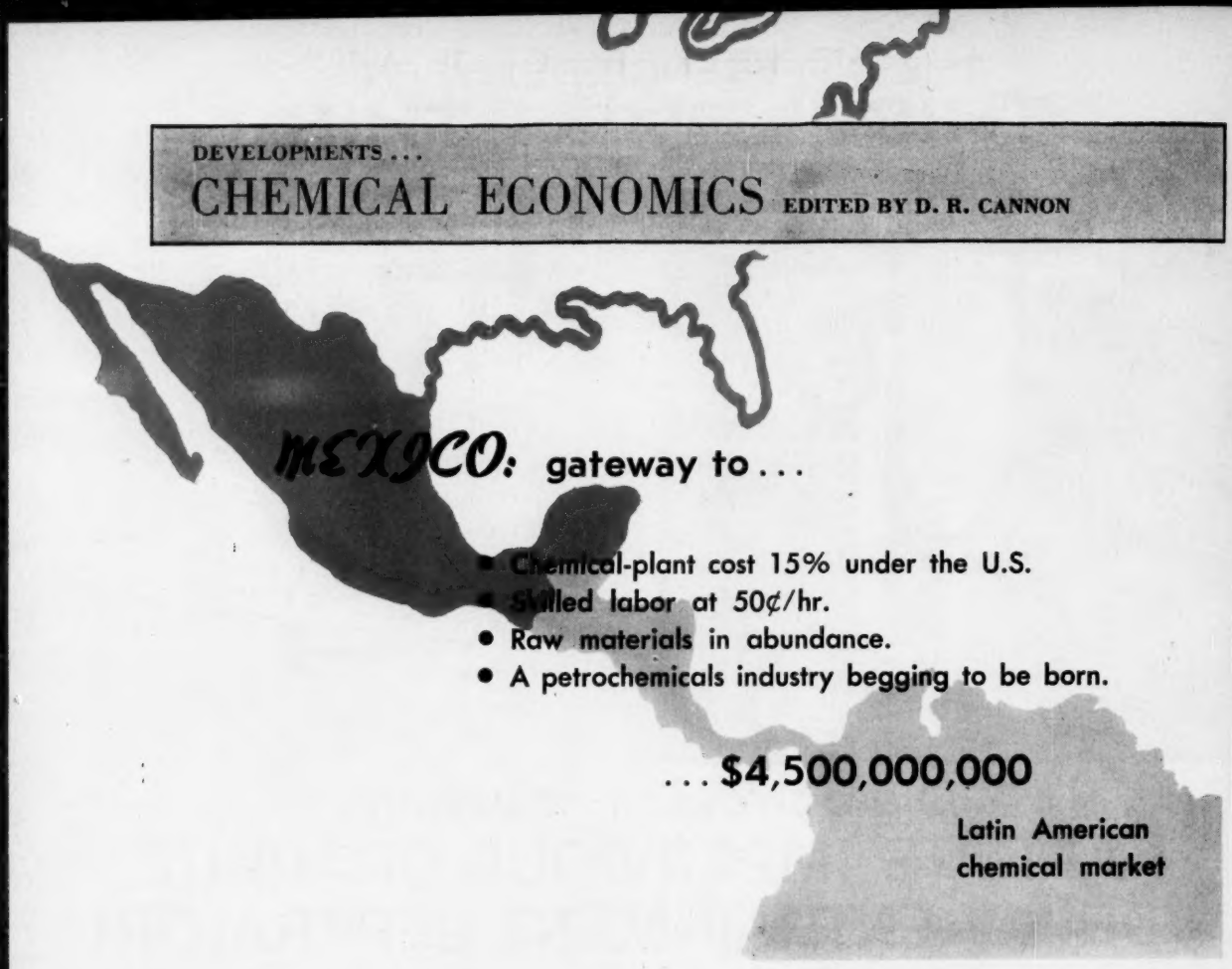
MEXICO: gateway to . . .
• Chemical-plant cost 15% under the U.S.
• Skilled labor at 50¢/hr.
• Raw materials in abundance.
• A petrochemicals industry begging to be born.
. . . $4,500,000,000
Latin American chemical market

Chemical Men Look South of the Border

Frank B. Loretta, E. I. du Pont de Nemours & Co., Wilmington, Del.

To really "see" the chemical opportunities inside Mexico, U.S. chemical processors must look outside Mexico—beyond her borders to the southward, to Central and South America. For Mexico is an entree to the growing chemical markets of all Latin America — markets expected to top $4.5 billion by 1965.

And if, as is likely, some sort of Latin American common market group, or groups, emerges, Mexico, as an "insider," has good chances of selling chemicals to the other countries of Latin America.

▶**Good Setting** — The Mexican climate, both political and economic, is generally favorable to chemical investment. Basic chemical raw materials are there in abundance. Skilled labor is relatively inexpensive. Engineering, equipment and building costs are lower than in the States.

A vigorously developing chemical industry is already in existence in Mexico. No new U.S. entry has to "go it alone." On the other hand, some $150 million worth of chemicals must still be imported each year to serve slowly, but firmly, expanding Mexican markets.

On the debit side: difficulties in quantitative market appraisal, limitations of Mexican law, policies toward foreign investors. And you may expect to encounter more than the usual problems in finding suitable plant sites, skilled workers and good service facilities.

▶**Plant Costs**—Mexico has facilities for fabrication of steel, aluminum and stainless steel vessels, welded and built in accord with U.S. standard codes. Although steel costs are comparable to those of the States, equipment runs less on account of cheaper labor.

Mexican costs for steel equipment, including structures, platforms, tanks, etc., may be about 75% of U.S. costs. Smaller

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FRANK LORETTA is president and general manager of Du Pont, S.A. de C.V., and Cia. Mexicana de Explosivos, S.A., Mexico. This article is based on a talk he gave at an American Institute of Chemical Engineers meeting in Texas.

BUILD SPECIAL PROPERTIES INTO "TAILOR-MADE" POLYMERS WITH

VINYLPYRROLIDONE

CONTROLLED SOLUBILITY
DYE RECEPTIVITY
EMULSIFICATION
SURFACE ACTIVITY
ADHESIVENESS
STRENGTH
COMPLEXING ACTION

These are some of the many properties which may be "built into" copolymers to meet specific needs.

Vinylpyrrolidone, a versatile liquid monomer, copolymerizes readily with other monomers. Vinylpyrrolidone also reacts with phenols to form valuable addition compounds.

Vinylpyrrolidone offers a new approach to a wide variety of polymeric products, including synthetic fibers and films, lube oil additives, adhesives, coatings and finishes, glass fiber laminating resins, and textile sizes. If you work with copolymer systems, see what Vinylpyrrolidone can mean toward product improvement.

For information on handling properties, shipping containers, etc., write for Booklet 6-7.

ANTARA CHEMICALS
A SALES DIVISION OF
GENERAL ANILINE & FILM CORPORATION
435 HUDSON STREET, NEW YORK 14, N.Y.

savings accrue from local fabrication of stainless steel equipment since this material must be imported. You can save in the order of 10% on piping installations.

Pumps of the most usual types are manufactured in Mexico. Fabrication of steam boilers has begun. Some types of rotary dryers and kilns are also available locally. However, alloy valves, fittings and flanges must be imported.

Civil constructions and buildings are cheaper in Mexico—about $5/sq. ft. of building—due to lower cost of materials and labor.

Mexican firms will contact for engineering and design services at a cost 25-35% of that prevailing in the U.S.

▶**Save 15%**—Thus, it is estimated that a chemical plant can be engineered and built in Mexico for about 85% of the cost of an equivalent plant in the States.

There is plenty of unskilled labor in Mexico. Semiskilled labor is available at the urban centers. Skilled labor, such as top mechanics and electricians, can be purchased for 40-50¢/hr., but is not at all plentiful. Operators must be trained by newly formed companies. Wages vary between $0.40-1.00/hr.

Labor relations in Mexico have improved considerably in the last 12 years. No strikes or labor problems of importance have occurred in the chemical industry to date.

▶**What's the Market?**—One of the first problems faced by the chemical processor itching to move into Mexico is market appraisal. Even though Mexico has a fair-sized, active and diversified chemical industry, accurate information about it is not readily available even to the government, which often has to rely on trade and other sources for data.

More certain is an appraisal of Mexico's wealth of chemical raw materials; she has abundant reserves of petroleum, natural gas, sulfur, coal, zinc, lead, mercury, iron ore, salt, phosphate rock, fluorspar and naval stores.

Another way to look for chemical opportunities in Mexico is to check itemized lists of chemical imports—which, significantly, added up to $150 million in 1958, 12% higher than in previous years.

▶**Organic Field Wide Open**—Most of the imports are organic chemicals, for this is the branch of Mexico's chemical industry that has been exploited the least. Production consists mostly of primary coal-tar products (practically no dyes, intermediates or drugs are made), ethyl alcohol from molasses, aniline oil, crude and refined naphthalene, glycerin, acetic and other organic acids.

The plastics industry depends entirely on imported resins or monomers, with the exception of phthalic anhydride and formaldehyde. Synthetic fibers are in the same boat as plastics, in terms of dependence on imported raw materials. Integration backwards will provide several opportunities for chemical plants as demand increases.

▶**Petrochemicals Ahead**—Mexico needs a basic petrochemical industry—and will start getting one soon. Lack of capital, among other problems, has retarded development of this industry by the government-controlled petroleum monopoly, Petroleos Mexicanos (PEMEX). Aggressive government action is planned to remedy this.

In December 1958, the Mexican government decreed that the government, through PEMEX, would have absolute control over all basic petrochemical products. Production of all non-basic petrochemicals would be left to private industry. Since the borderline between basic and non-basic is difficult to define, the government will decide which products are its exclusive responsibility.

Quite obviously, then, a prospective investor in the chemical industry in Mexico must know the law with respect to taxes, natural resources, foreign investment, saturation of industries, etc. Time does not permit my dwelling on these points, but suffice it to say that forest, mineral and water resources are federal property.

Foreigners cannot own land within 50 km. of the coast, or 100 km. of the border. There are a number of industries where the law stipulates that ownership must be at least 51% Mexican. Further, the tendency is toward encouraging more Mexican capital in all new ventures.

Mexican taxes on investments are not among the lowest in Latin America. Net taxable income from industrial enterprises is subject to a normal income tax, the overall rate of which is limited to 39%. Inasmuch as such enterprises are also subject to a 15% "distributable profits tax" as well as an excess profits tax, the Mexican corporate tax burden can reach the U.S. rate of 52%.

▶**Location Problems** — Good plant sites for chemical manufacture are not easily found in Mexico. So far, most of the chemical industry has located in Mexico City and surroundings, from which the center of the country—and 70% of the national market—can be served.

The water supply in Mexico City environs, however, is not particularly good, especially if relatively large amounts are required. Waste disposal is very difficult due to the lack of good-sized streams.

Ample water and waste disposal means are available at several points along the coasts. But power supply at many of these locations is not reliable and must be supplemented by emergency plants.

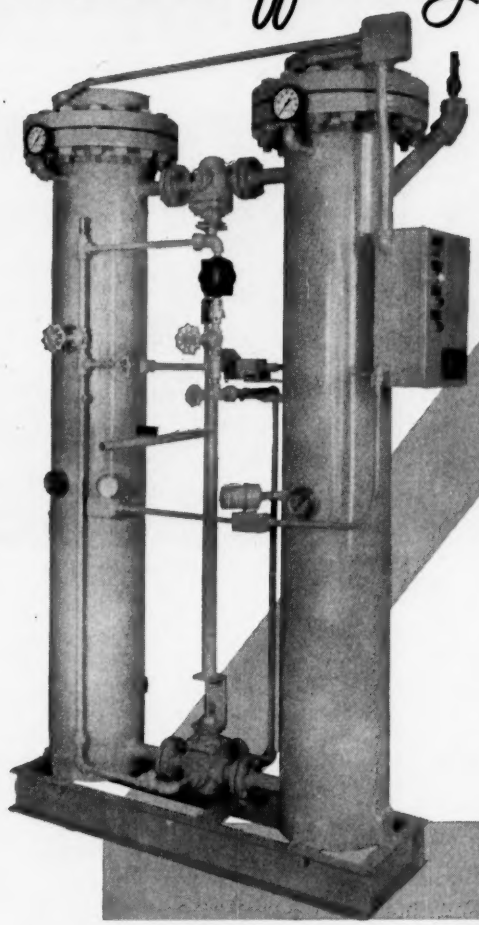
Areas outside Mexico City are being developed into industrial centers, however: Queretaro, Salamanca and Zacapu, in the center of the country; Tampico; and the Isthmus of Tehuantepec. Good living conditions, good communications and plenty of water make Tampico and surroundings one of the best locations for the chemical industry.

More on Mexico

In our next issue, Mr. Loretta winds up his survey of chemical opportunities in Mexico—with some close attention to inorganic chemicals.

KEMP ORIAD DESICCANT DRYERS

cut costs, add efficiency 4 ways!



1 Complete reactivation

An exclusive 3-zone embedded heater design gives every Kemp Oriad Desiccant Dryer extra drying power *economically* (effective distribution of heating elements assures high heat transfer efficiency). The most complete reactivation results... providing maximum desiccant capacity, minimum dewpoint performance.

2 Full automatic operation

Set the program timer and everything is regulated automatically. Gases are dried with the least pressure loss, lowest maintenance and operating costs. Your choice of manual or semi-automatic systems, too.

3 Accurate temperature control

Thermostatic control conserves heat input... maintains ideal temperatures for highest operating efficiency in drying instrument air, process air and gases to the lowest dew point, eliminating condensation or freeze-up, and other applications.

4 No moving parts

There are no blowers, fans or motors to create maintenance problems, rising operating costs. Unit comes fully assembled, ready to install and operate. Write today for Bulletin D-103, or contact your Kemp man, listed in the *Chemical Engineering Catalog*.

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THE C. M. KEMP MANUFACTURING COMPANY
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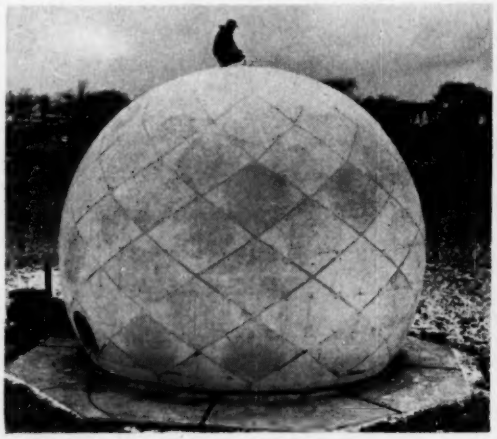
CHEMICAL PRODUCTS EDITED BY FRANCES ARNE



PREFABRICATED panels for radome.

FOAMED-IN-PLACE for personnel.

The Military Discovers Foam-Dome Shelters

Designed to meet a growing need for ground shelters providing greater dielectric "transparency" to minimize energy loss and boresight error in radar tracking installations, the world's first polyurethane foam radome has been erected at Ottawa, Ontario, by Canada's National Research Council.

The radome, including joints, is constructed entirely of foam. With an equatorial diameter of 26½ ft., the structure consists of 115 pre-molded rigid foam panels in nine different geometric shapes and sizes. Requirements calling for the use of a fire-resistant polyurethane was met by using Hetrofoam 10 resin, a Hooker product.

Development program was sponsored jointly by the Royal Canadian Air Force and the National Research Council.—Hooker Chemical Corp., Niagara Falls, N. Y. 78A

Spraying in a short time a complete hemispherical shelter of foamed plastic, Atlantic Research Corp. scientists and Army technicians have demonstrated a technique which promises to provide long-lasting shelters of very light weight and low cost.

The shelter, 12 ft. in dia. and 6 ft. high, was formed by spraying a rigid polyurethane plastic foam onto an inflated canvas hemisphere. Foam rises in minutes and hardens in less than an hour.

Weighing under 200 lb., dome is almost completely impervious to the elements. A better insulator than cork, the 1½-in. foam can be cut with a knife making possible windows, doors and other apertures in any desired spot. The ease of formation and light weight of the final structure make the foam ideal for field use.—Atlantic Research Corp., Alexandria, Va. 78B

Ceramic Brick

Alumina formed into brick for nuclear, chemical use.

A material of extreme refractoriness has been made into a high temperature lightweight insulating brick. Formed to 2½ by 4½ by 9 in., this exclusive formulation of aluminum oxide material is expanded and then fired.

A cellular structure is created in which all cells are interconnected. Thus, its absorbent property permits gas to pass through for purging or evacuation. This ceramic material has the density or weight of a 1,600 F. insulating firebrick, and an insulating value comparable to a 2,300 F. insulating firebrick. Yet, it can be operated up to 3,400 F. It can readily be cut, sawed, or filed.

This insulating ceramic material has a wide range of application in the nuclear, metallurgical, chemical and aeronautical industries. In the high temperature metallurgical field it should find acceptance as

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SOLVAY CAUSTIC POTASH

When you start with a more reactive material like Solvay® Caustic Potash, you usually get better results. Many users prefer it to caustic soda because it enables them to produce more soluble reaction products and less viscous solutions.

For example, its high solubility permits liquid end products having high soap concentration. Many heavy-duty liquid detergents would not exist were it not for ingredients derived from caustic potash.

Its high reactivity is also useful in mercaptan extraction and desulfurization of petroleum products. Caustic potash solutions effectively absorb carbon dioxide and hydrogen sulfide in industrial gases. Dry forms are highly hygroscopic, excellent for dehydration.

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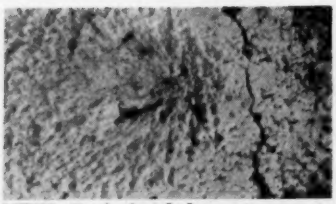
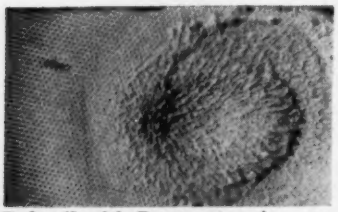
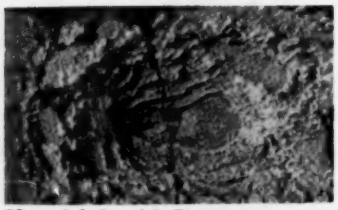
lining for hydrogen furnaces, for vacuum processing, and as a catalyst support in generators. —Ipsen Industries, Inc., Pecatonica, Ill. 78C



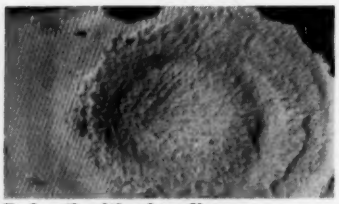
NEW: Resin bonded quartz.



Refrasil with Pyropreg resin.



Glass fabric with Pyropreg.



Refrasil with phenolic.

Heat Resistant Material

Ablation loss of new material, top, is low compared with competitors'.

The special property of exceptionally low ablation loss under extreme conditions is attributable largely to the use of quartz in a new material called Resin Bonded Quartz Sheet. Finely divided particles of fused quartz are bonded together with company's temperature resistant Pyropreg resin. A small percentage of glass or other fiber is included to give the sheet good handling properties.

The fused quartz particles have an extremely low coefficient of thermal expansion. Melting point of the quartz is in excess of 3,100 F., and the resultant liquid is extremely viscous so that it is not washed off the surface but tends to act as an insulator for the material which is not yet melted.

The low ablation loss feature is apparent in the photographs, left. All four panels have been tested in the 5,500 F. blast of an O-H rocket motor for sixty seconds. Top panel of resin bonded quartz sheet shows little loss of material, very shallow penetration, almost complete lack of warpage. Second panel, Refrasil (high silica material) cloth impregnated with Pyropreg resin, shows a deeper crater, considerable warpage. In the third panel, consisting of 181 glass fabric with Pyropreg resin containing a small amount of finely divided quartz particles, considerable loss of material is evident, but no sign of delamination and very little warpage. In the fourth panel, of Refrasil cloth impregnated with phenolic, ply loss has started and a fairly deep crater formed. There was little delamination and considerable warpage.

Resin bonded quartz sheet is not a structural material, and in the cured form has physical properties comparable to the resin itself. Its strength is ample for shielding properties but contributes little to the over-all structure. Company recommends using it as a facing on a laminate of standard Pyropreg reinforced plastic.

Product is priced lower than standard pre-impregnated glass fabric, which is several times lower than high silica materials such as Refrasil, and many times lower than pure quartz fabric reinforced materials.—**Cordo Chemical Corp., Norwalk, Conn.** 80A

Refractory

Withstands 3,000 F. for several hours.

Asbestosite, a new refractory material developed for use under extremely high temperature conditions, has been announced. The material is said to withstand continual exposure to temperatures in the 1,000 to 3,000 F. range and is also capable of being subjected to much more elevated temperatures during intermittent periods of time.

A tough fibrous material, it is easily fabricated in a wide variety of shapes and sizes and

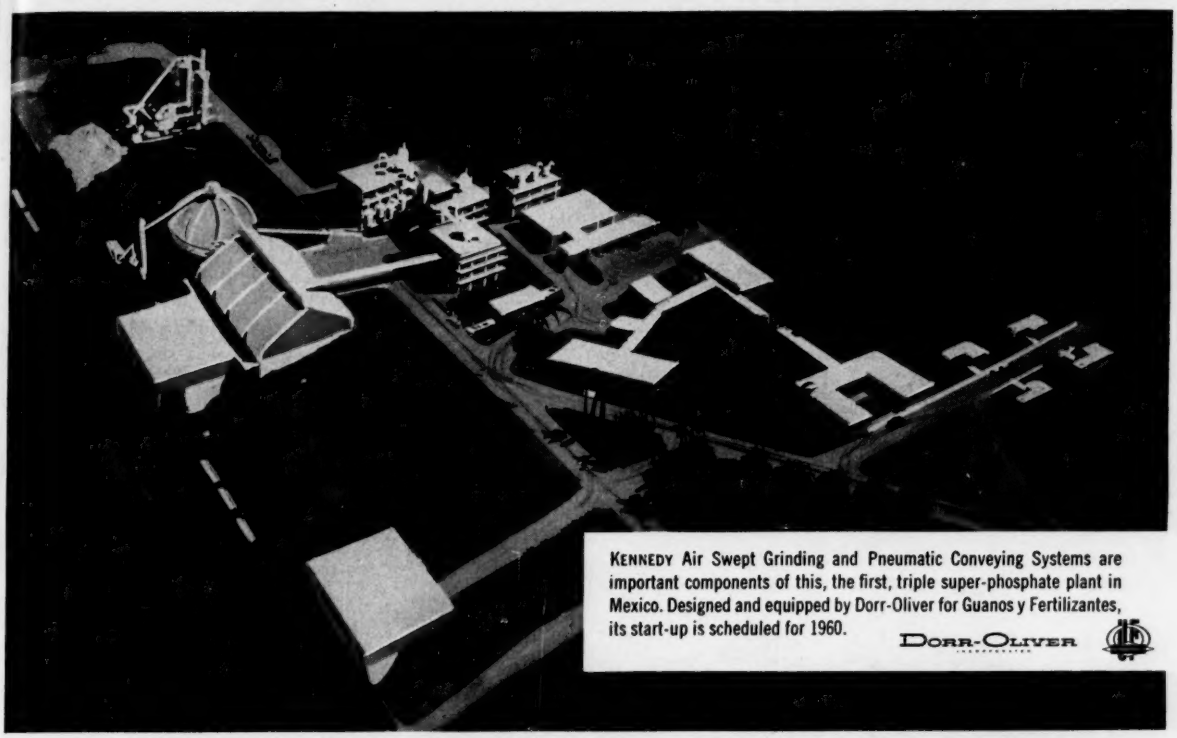
Newsworthy Chemicals

Page Number is also Reader Service Code Number

Urethane foam makes more efficient radome..... 78A
Foamed-in-place igloo, modern portable field shelter..... 78B
Alumina formed into brick for wide nuclear use..... 78C
Resin bonded quartz gives extra heat resistance..... 80A
Refractory stands 3,000 F. for hours..... 80B
Porky tire design spawns exotic vehicles..... 82A
New refrigerant use: keeping satellites in position..... 82B
N-butyronitrile available in development quantity..... 82C

For more details, use Reader Service Card

KENNEDY for grinding & conveying phosphates

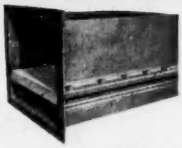


KENNEDY Air Swept Grinding and Pneumatic Conveying Systems are important components of this, the first, triple super-phosphate plant in Mexico. Designed and equipped by Dorr-Oliver for Guanos y Fertilizantes, its start-up is scheduled for 1960.

DORR-OLIVER

KENNEDY Ball Mills are noted for high tonnage and low cost processing of phosphate rock and other agricultural chemicals:

- Lowest maintenance cost—cannot be jammed or damaged by tramp iron or other foreign material
- No periodic shut downs for wearing part replacement
- Grinding media is replaced without interruption
- High capacity and product fineness remain constant—month after month
- Careful basic design and pressure lubrication assure high mechanical efficiency
- Reliable feed control and overall reliability provide high production with minimum manpower
- Higher capacity in single units—less space and structural steel per ton of capacity and lower initial investment.



KENNEDY AIR-FLOAT Conveyors provide trouble-free air-gravity conveying of dry materials:

- There are no moving parts—nothing to wear—nothing to maintain
- Only small volumes of low pressure air are needed—uses less power
- Operates quietly—has high capacity—requires little headroom
- The conveyed materials are completely enclosed—there is no dust
- Permits flexible design—directional changes are simple
- Can be made from corrosion resistant alloys
- Eliminates lubrication, complicated gears, belts and chains, spare parts and down time for maintenance.

Consult KENNEDY for further details. Let us show you the many advantages KENNEDY equipment can offer you.

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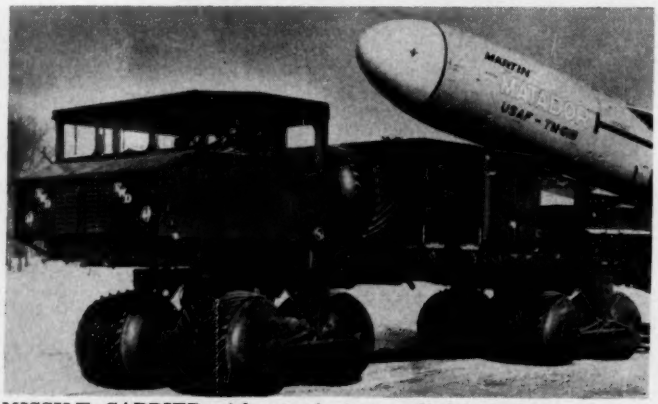
Porky Tire Design Spawns Exotic Vehicles



MISSILE CARRIER—Advent of stout, cylindrical tire 5 yr. ago inspired new vehicles for applications barred to conventional tires.

TREE-KNOCKER—Called Terra-Tires, they're from 16 in.-5 ft. high, sometimes equally wide. They move over rocks, mud, sand, snow.

"NO-RUT" TRACTOR—In addition to those in photos, vehicles include marsh buggies, scrapers.—Goodyear Tire & Rubber, Akron. 82A

company plans on making the material available in metal-clad configurations.

Strong, rugged and possessing the ability to withstand extreme thermal shock, Army Ordnance has evidenced interest in Asbestosite for use in heavy tank exhaust systems. Surveys involving its use in rocket and jet constructions and in cases where materials in a liquid state are to be transferred at extremely high temperatures, are also underway.

Studies show that Asbestosite materials to be used as tubing, or that may be subjected to heating from within, can definitely be formulated to withstand temperatures above 3,000 F. for several hours. Company suggests that Asbestosite muffiers, installed as original equipment on automobiles might never require replacement.—**Harco Laboratories, New Haven, Conn. 80B**

BRIEFS

Tetrafluoromethane refrigerant, Du Pont's Freon-14, is now helping keep the nation's Discoverer satellites positionally stable as they spin around the earth. It is used along with nitrogen to provide the thrust in tiny reaction jet nozzles on the final stage of the Discoverer.—**Du Pont Co., Wilmington, Del. 82B**

Specialty solvent and chemical intermediate, n-butyronitrile, is now available in development quantities at $1/lb. Company has developed a commercial process for its production.—**Eastman Chemical Products, Inc., Kingsport, Tenn. 82C**

For More Information

about any item in this department, circle its code number on the

Reader Service

postcard (p. 183)

"Let's talk about the cost of efficient crystallization"

A report by Hans Svanoe
Consultant
Struthers Wells Corp.

An alarming trend toward price buying of crystallizers has become evident. Purchase price, while certainly an extremely important consideration, should not, and in fact, cannot economically be the only consideration in the purchase of a crystallizer system.

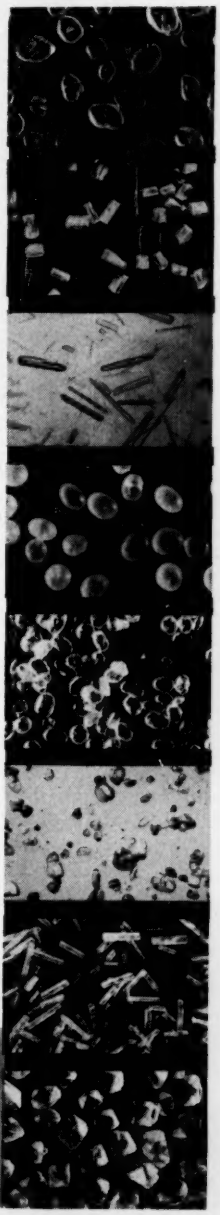
The cost of the crystallization process goes far beyond the purchase of the crystallizer itself. All the features of a crystallization system which lead to more economical operation should, and must, be weighed. For example, a complete crystallization system should include these operating economies: money-saving steam features; high product purity; controllable and uniform crystal size; efficient separation of crystals and mother liquor; reduction of wash water; economical dryer operation; dust reduction; and reduction of material caking.

We firmly believe the crystallization know-how here at Struthers Wells will provide all these economy features and more. For instance, we do not supply a basic unit, then let you fit it to your needs as best you can. The Struthers Wells crystallization system is a *complete* package, *tailor-made* to *your* own requirements for purity, bulk density, free flowing characteristics, or other specific properties. The only truly economical way to judge the cost of crystallization is to weigh the over-all investment of this complete system with all of its inherent money-saving advantages, against the single unit which may not meet your specific needs.

Struthers Wells has pioneered the design and fabrication of hundreds of commercial installations according to scientific principles. We have long recognized that both nucleation and crystal growth must be controlled throughout the crystallization process in order to obtain high purity materials from impure solutions. This, we accomplish with maximum economy.

It is obviously beyond the scope of this report to delve into the engineering data on our evaporator, vacuum, cooling, batch and special crystallizers. Therefore, we suggest that you send for our 16-page Engineering bulletin which describes the basic details of Struthers Wells crystallization systems and the varied services we offer.

Just write to the address below for your copy of this informative treatise on modern, efficient crystallization systems.



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Plants in Warren, Pa. and Titusville, Pa.

For additional information and address of your local Struthers Wells representative, see Chemical Engineering Catalog, pages 1541 to 1560.

Struthers Wells

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Crystallizers . . . Direct Fired Heaters . . . Evaporators . . . Heat Exchangers . . . Mixing and Blending Units . . . Quick Opening Doors . . . Special Carbon and Alloy Processing Vessels

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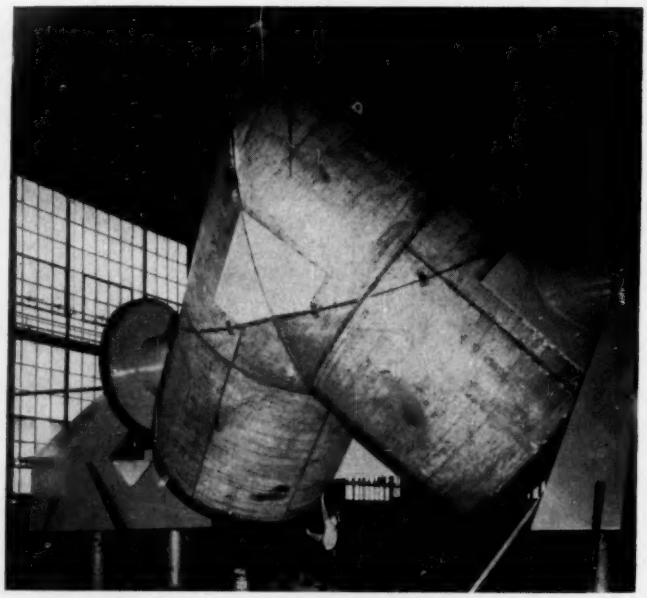
PROCESS EQUIPMENT

EDITED BY C. C. VAN SOYE



World's Biggest Blender or World's Smallest Man?

It's the blender that's uncommon in size—over 20 ft. high! Designed for a working capacity of 1,700 cu. ft./batch, it will be installed at the end of a continuous process line to maintain uniformity of a plastic powder product. When fully charged, the 30-ton "Twin Shell" rotates at 4 rpm. to create a divergent flow pattern that results in the required blending effectiveness. Material of construction is ¼-in. Type 304 stainless steel.—The Patterson-Kelley Co., Inc., East Stroudsburg, Pa. 84A

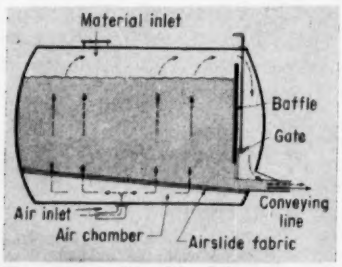
Centrifuge Developments

Three manufacturers have new or improved units.

Designated, SRG-214, an all-hermetic, 5,000-gph. centrifugal separator will separate or clarify viscous or flammable materials, or feeds that must be kept from contact with air. The machine is particularly applicable for water washing of long-chain plastic materials under conditions of high temperature and pressure. A disk-type unit, the centrifugal has a bowl diameter of 24 in., and bowl speed of 4,400 rpm.—**The DeLaval Separator Co., Poughkeepsie, N. Y. 84B**

Originally developed for food and fiber production, a new automatic-discharge centrifugal dryer was introduced to the entire process industries at the recent Chem Show. According to the manufacturer, an outstanding feature is design of the discharge mechanism. Instead of plows or push mechanisms, the entire basket bottom drops out of the machine for rapid discharge without crystal fracturing. Controls normally furnished with the unit include contactors for main and loading drive motors, timers, relays and interlocks.—**The American Tool & Machine Co., Boston, Mass. 84C**

Also shown for the first time at the Chem Show was Bird's 6-in. continuous solid-bowl centrifugal. Chief feature of this unit is extreme ease of disassembly. Instead of a mount between two bearings, the bowl is overhung. This makes inspection and cleaning procedures quite easy. Bird anticipates that the centrifugal will be a valuable tool for pilot-plant study of solid-bowl centrifugals, or of centrifugal-based processes. Operating at speeds to 6,000 rpm., the machine's capacity exceeds 600 gph. slurry, 500 lb./hr. solids.—**Bird Machine Co., South Walpole, Mass. 84D**



Pneumatic Carrier

Self-discharging trailer can feed to pneumatic lines.

With the new Airslide Pump, dry bulk material may be conveniently hauled between locations, and then discharged to a plant's pneumatic lines. A

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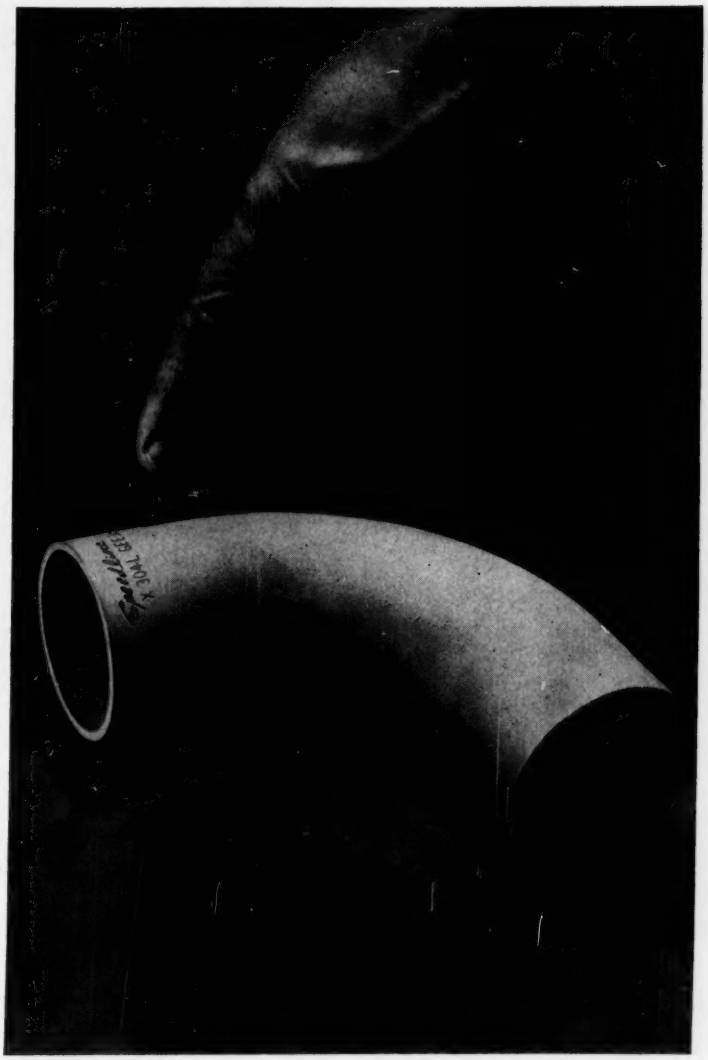

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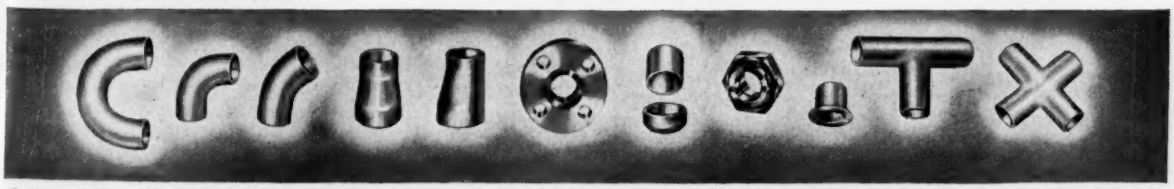
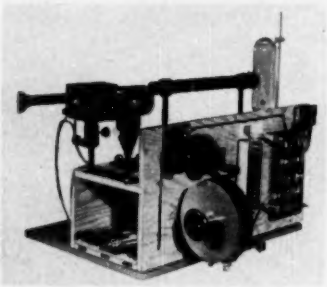


A Product of HORACE T. POTTS COMPANY • 500 E. Erie Avenue • Philadelphia 34, Pennsylvania

single air supply provides pressure for unloading, feeding and conveying.

Essentially a tank in structure, the unit is of lightweight construction, increasing permissible payload within weight limitations. Applications already successfully field-tested include hauling and unloading of cement, fly ash, etc.

In operation, blower-supplied air enters the lower chambers of the conveyor. Air filters up through permeable membranes that form the tops of chambers, thus fluidizing material above the membranes. This reduces the angle of repose, enabling particulates to flow by gravity down the slope of the conveyor to a discharge opening. Air then rises over a baffle to mix with material flowing through the discharge gate.—**Fuller Co., Catasauqua, Pa.** 84E

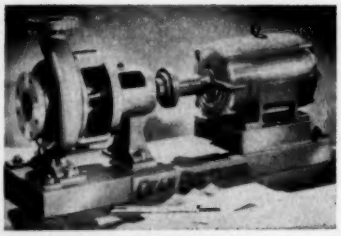


Pyrometer Calibrator

Assures reliability of field instruments.

Model No. 107 Optical Pyrometer Calibrating Set is claimed to be a versatile and precise unit that will permit accurate and simultaneous calibration of any two optical pyrometers, irrespective of manufacture. Each set comes as a totally packaged unit, ready to use.

A wide filament, strip-type lamp adjusts by step and vernier rheostats to any desired temperature in the range from 1,400 to 4,200 F. Suitable instrument holders and brackets permit mounting of various pyrometer models.—**Pyrometer Instrument Co., Inc., Bergenfield, N. J.** 86A



Chemical Pump

Corrosion-resistant line offers many features.

Available in any of 17 different alloys for use in corrosion service, the new "pH" process pump offers high performance and flexibility of application. It has a full-open impeller with smooth, unobstructed inlet passages that allow handling of slurries at high capacity with no increase in radial thrust. Single-piece construction with integral stuffing box prevents misalignment with the shaft.

Centerline suction and discharge connections simplify piping layout and pump installation. Design permits interchangeable installation of either packing or mechanical seals in the field, with no modification of pump or stuffing box.

Horizontal or vertical models are each available in 14 sizes. Disconnection of piping or motor is not necessary for pump disassembly.—**Dean Bros Pumps, Indianapolis, Ind.** 86B

Fluid Energy Mills

Selected linings up purity of ground product.

Trost Jet Mills, new machines for particle-size reduction, eliminate contamination of materials being ground. Frequently, abrasion of the walls of grinding and collecting chambers within conventional fluid energy mills leads to products containing contaminants. Trost mills stop such abrasion via wall-surface linings of materials such as tungsten, boron carbide, rubber or ceramics.

A wide variety of sizes, ranging from production units with capacities of many tons/hr. to laboratory mills that will grind as little as 1 lb./hr., are available. Provisions for cooling during operation or for controlled atmospheres are optional.

As part of the system, an effective classifier controls final maximum particle size from fine sieve meshes to less than 1 micron. In typical operation, a Trost mill ground titanium boride to 80% below 1 micron. —**Engineered Materials, New York, N. Y.** 86C

For More Information . . .

about any item in this department, circle its code number on the

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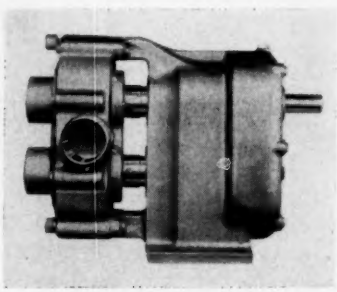
postcard (p 183)



Rotary Pump

Stainless unit operates at low speed. Long life.

After two years of development, Waukesha's new, 316 stainless steel, positive-displacement pump is available for slow-speed, heavy-duty operations. The manufacturer states that the new pump operates with low turbulence, pulsation, aeration and agitation, with liquids of either high or low viscosity.

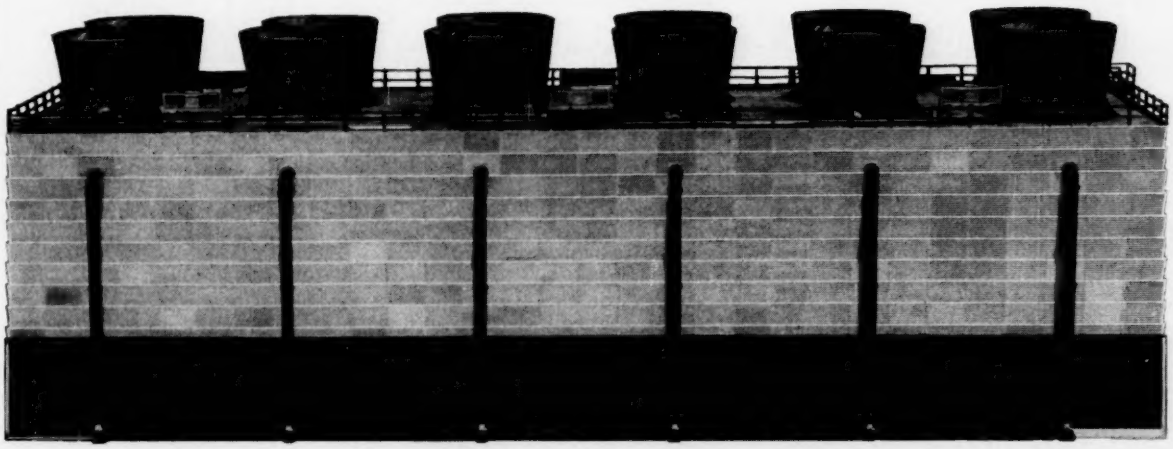
Features include helical timing gears, twin balanced impellers, and single or dual mechanical seals. The pump also comes with packing-gland seal construction.

Initially, the self-priming pumps will be offered with capa-

FLUOR

over 40 years of

*Since 1919 Fluor has been building cooling towers throughout the world. (An average of one new industrial or commercial cooling tower is erected by Fluor every three days.)



Ask for our brochure that shows why Fluor Towers mean more efficient operation.

COOLING TOWER experience at your service *

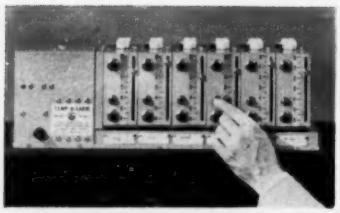
Fluor PRODUCTS COMPANY

INDUSTRIAL COOLING TOWERS

A division of The FLUOR CORPORATION, Ltd.

GENERAL OFFICES:
SANTA ROSA, CALIFORNIA

cities to 100 gpm. against head pressures of 200 psi.—**Waukesha Foundry Co., Pump Div., Waukesha, Wis.** 86D



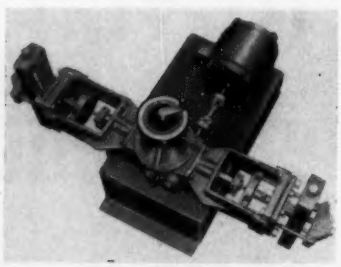
Temperature Monitor

Detects overheat conditions; also underheat.

Called Temp-O-Larm, a new device triggers an alarm when temperatures in designated production equipment reach preset limits. In operation, a thermostat sends the signal to an annunciator that emits audible and/or visible alarms.

Each annunciator has an alarm-time delay that adjusts from 0 to 6 hr. This component eliminates the possibility of false alarms during expected and normal overheat temperatures. Only when the danger temperature lasts for a period longer than the time-delay setting does the warning sound.

Temp-O-Larm comes in two models, one for seven to twelve production units, the other for one to six units.—**Kidde Ultrasonic & Detection Alarms, Inc., Clifton, N. J.** 88A



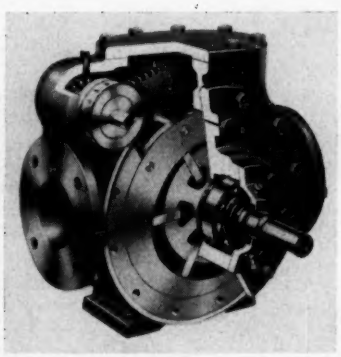
Metering Pumps

Versatile line for single or multiple blends.

Wallace & Tiernan, Inc. has just started production of a new metering pump line. Electrically driven, Series 200 pumps are positive-displacement, reciprocating, plunger-type units. They come in a wide range of capacities, from 0.65 to 2,025 gph.

To increase versatility, pump drives are designed to function with one, two or three liquid ends. These may be changed as complete units for different capacities or liquids. A number of Simplex, Duplex or Triplex units may be coupled to the same drive shaft for simultaneous blending of two or more liquids.

With a metering accuracy within ±1%, standard models operate against pressures to 4,000 psi. All parts contacting solution are made of corrosion-resistant materials.—**Wallace & Tiernan, Belleville, N. J.** 88B

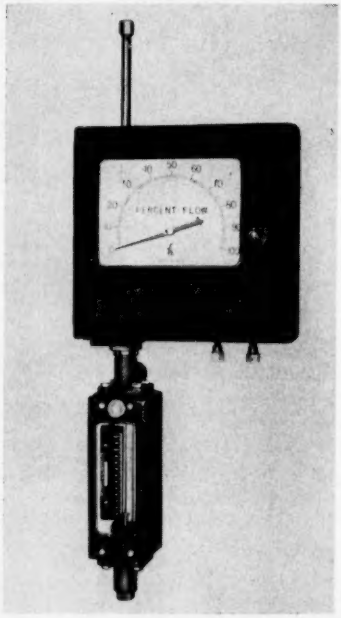


Vane Pumps

In-service output change without variable drives.

Known as the Vari-Flo line, a new series of efficient, vane-type pumps features a simple means for changing displacement to vary delivery from zero to full capacity while running at constant speed. Combined with other standard components, Vari-Flo units will provide a relatively simple system to produce any desired blend ratio of a base stock.

Variations in flow are controlled via a graduated dial that can be adjusted manually or automatically, with a variety of optional arrangements for special applications. Without changing rotation or speed, the pump can even reverse its flow to evacuate discharge lines after shutoff.—**Blackmer Pump Co., Grand Rapids, Mich.** 88C



Transmitting Rotameter

Pneumatic system claims accuracy, easy calibration.

Chief feature of a new, pneumatic, transmitting rotameter for air-signaling fluid rates of flow to remote-located recorders and controllers is the ease with which it can be calibrated. Four calibration adjustments permit accurate field recalibration whenever basic operating conditions change. No cams are used for adjustment.

Designated Model 58, the pneumatic transmitter is a position-balance unit. Variations in supply air pressure, between 20 and 25 psig., have little effect on its accuracy.

Metering float of the rotameter has an extension rod that rises into the transmitter case. As a magnet on the rod

EQUIPMENT NEWS
Continues on . . . Page 170

DU PONT IMPROVES

VITON®

SYNTHETIC RUBBER

- NOW GIVES TWICE THE SERVICE LIFE AT 600°F.
- OFFERS GREATER RESISTANCE TO CHEMICALS AND SOLVENTS

VITON's remarkable resistance to heat and fluids has already improved performance of components for appliances, autos, aircraft and many types of industrial equipment. Now the ability of this new synthetic rubber to withstand heat and chemical exposure has been extended to even greater limits. Here are some of the properties of the new high-performance grade, now commercially available in a wide range of products.

Improved resistance to heat aging—When oven-aged in air at 400° F. or less, VITON vulcanizates now remain usefully elastic for *indefinite periods*. At higher temperatures, they can be expected to remain usefully elastic for more than:

3000 HOURS @ 450° F.
1000 HOURS @ 500° F.
240 HOURS @ 550° F.
48 HOURS @ 600° F.

Improved resistance to fluid exposure—VITON now has better resistance to nitric acid, glacial acetic acid and hydrochloric acid, as well as to certain aromatics and diester lubricants. Its proven resistance to a wide variety of oils, solvents, fuels and chemicals remains unequalled among synthetic rubbers.

Complete information—Learn more about VITON, and how it can improve the products you make and use. Technical literature just published will give you all the facts. Write to E. I. du Pont de Nemours & Co. (Inc.), Elastomer Chemicals Dept. CE-2, Wilmington 98, Del.

DU PONT
REG. U. S. PAT. OFF.

SYNTHETIC RUBBER
NEOPRENE HYPALON® VITON® ADIPRENE®

Better Things for Better Living . . . *through Chemistry*

OTHER IMPORTANT PROPERTIES OF VITON

Hardness: 60 to 95 durometer on the Shore A scale.

Tensile strength: 2000 to 3000 psi. at room temperature, with elongation from 100% to 400%, depending on hardness; at 300° F., tensiles of 300 to 1000 psi., with elongation from 80% to 200%.

Compression set: VITON vulcanizates recover to within 90% to 97% of original dimensions when compressed 25% and held at 250° F. for 70 hours.

Low temperatures: Specimens 0.075 in. thick have a Young's modulus of 10,000 psi. at −20° F. and a brittle point of −47° F. A 0.010 in. thick coating of VITON on wire did not crack at −90° F., when bent around a mandrel 10 times the diameter of the wire.

Ozone and weather: VITON has withstood 28 days in 100 ppm of ozone, without a crack! After twelve months' exposure to direct Florida sunlight, it still remained in perfect condition.

Electrical: Typical values—DC resistivity of 1.4 x 10^{14} ohm-cm; specific inductive capacity of 8.53; power factor of 2.5%; dielectric strength of 412 volts/mil.

"H-25 PAYLOADER® power-steering and power-shift are the biggest advantages"*

*E. W. Carpenter, Plant Superintendent of G. B. C. Chemical Corp., Fairmount, Indiana also says, *"These features have greatly increased efficiency over any loader previously used. It is fast, and well-balanced for maximum load-carrying capacity."*

Marion Logan, the operator, adds, *"I get more production with less effort because of the easier, faster operation. The even, steady pull delivered by the new power-shift transmission gets full loads with less abuse to the machine."*

There are many reasons why the Model H-25 will dig, carry and deliver more tonnage with lower operating and maintenance costs than anything near its size. One is the power-shift transmission — exclusive in its class — with two speeds forward *and* reverse. Others are the power steer; power-transfer differential; 4,500 lbs. breakout force; 2,500 lb. carry capacity; shortest turning radius of only 6 ft.

The H-25 has been engineered to provide extraordinary protection against dust and dirt damage: triple air cleaner system; cartridge-type oil filter on all three oil systems; sealed, self-adjusting service brakes; parking brake enclosed in transmission; special grease and oil seals on all vital points.

Why not find out what a Model H-25 can do on your work? Ask your Hough Distributor for a demonstration, and ask about Hough Purchase and Lease Plans too.

THE FRANK G. HOUGH CO. 2-A-1
754 Sunnyside Ave., Libertyville, Ill.
Send data on new H-25 "PAYLOADER"
Name
Title
Company
Street
City
State

HOUGH®
THE FRANK G. HOUGH CO.
LIBERTYVILLE, ILLINOIS
SUBSIDIARY — INTERNATIONAL HARVESTER COMPANY

Flexonics joins a famous family

. . . to bring you better products and services

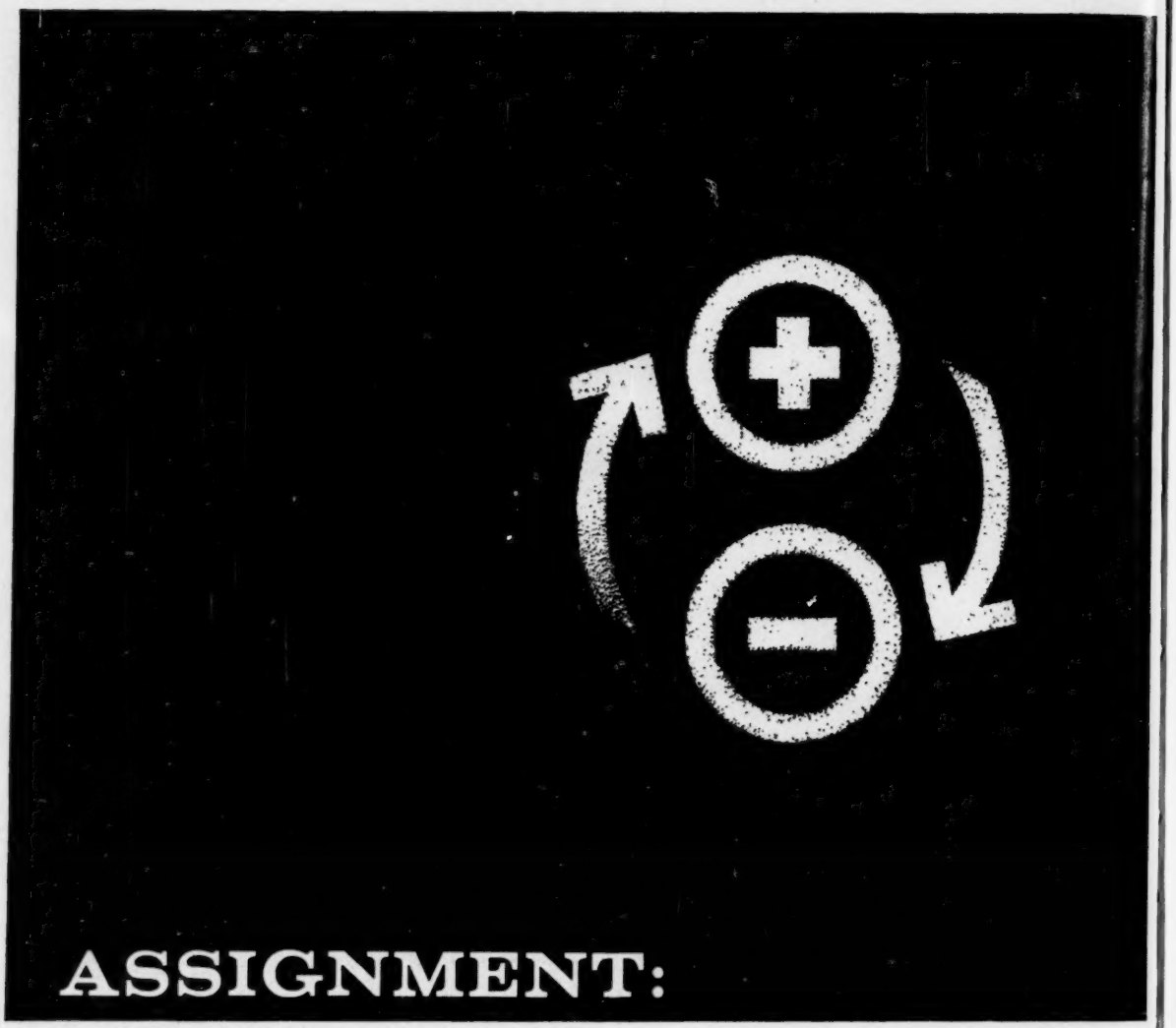
Flexonics Corporation's new affiliation with Calumet & Hecla, Inc., marks another important forward step.

Over its fifty-year history, Flexonics has become a major factor in the precision forming of thin metals—in the manufacture of metal hose, metallic bellows, expansion joints, hydraulic hose assemblies, automotive parts, aircraft and missile ducting systems—virtually everything for combined motion and fluid flow.

Calumet & Hecla now brings its broad industrial base to Flexonics technology. To industry, this means that new research and development facilities, new production capabilities, will soon be bringing you even better Flexonics products, an even wider range of Flexonics services.

The entire Flexonics organization is looking forward to serving you better . . . in more ways.

Flexonics corporation
1317 South Third Avenue, Maywood, Illinois
a subsidiary of **Calumet & Hecla, Inc.**



ASSIGNMENT: CORROSION

How Lukens *Application Research* can help you find the right steel plate for the job

Migrating ions—superimposed on a photomicrograph of corroded steel plate—symbolize one of metallurgy's oldest assignments: the battle against corrosion. Developing new tactics in this constant campaign is the job of our Application Engineering staff.

For example, called on early in the planning stages, Lukens engineers recently attacked almost identical problems for two large processing companies—and came up with two completely different solutions.

The first involved a sugar refiner's vacuum pans. Frequent and costly cleaning was required to head off corrosion and product contamination. Our staff's prior research and experience in the food equipment field led it to suggest *nickel*-clad steel for the pans. (13% and 8% nickel-clad on A-285 backing steel.)

Cleaning and maintenance were equally costly to a leading chemical and dye company—in the protection of its nitrogen solution barge tanks. Here, our engineers found *stainless*-clad steel the most desirable answer. (12% 304L on A-212 backing steel.)

Armed with practical as well as technical knowledge of Lukens' wide range of special-duty steels, our Application Engineers have helped conquer corrosion on many fronts. That's why we say . . . *if your assignment is corrosion, let it be our assignment, too.* Contact Manager, Application Engineering, **H-20 Services Building, Lukens Steel** Company, Coatesville, Pa.

Helping Industry Choose Steels That Fit The Job

LUKENS

ASK FOR THE BULLETIN ON LUKENS CLAD STEELS

STONE & WEBSTER BUILDS

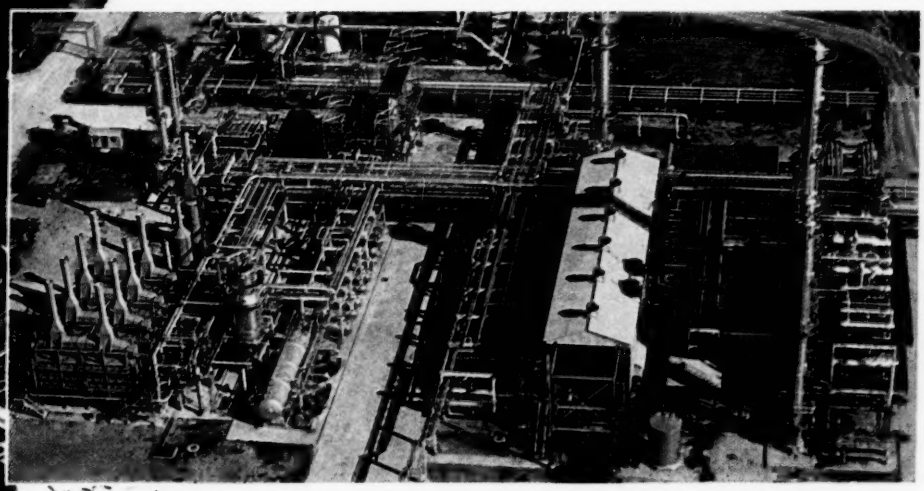
ANOTHER TEXAS BIG LEAGUER

Stone & Webster Engineering Corporation has recently completed the design and construction of a new ethylene plant at Port Neches, Texas, for the Jefferson Chemical Company. In recent years, Stone & Webster has built similar projects in Texas for Phillips Chemical Company and Gulf Oil Corporation.

The Port Neches plant, completed on schedule and well within the budget, more than triples Jefferson's ethylene and propylene production . . . and becomes the key installation in the expansion of their petrochemical production facilities.

In developing the plant design for high ethane and propane conversion rates, Stone & Webster engineers studied many processing schemes and feed stocks to achieve the flexibility required . . . a flexibility demonstrated by the fact that a high purity propylene can also be produced or the propylene recycled to make additional ethylene.

Let us demonstrate to you how Stone & Webster's skill and experience can assure a long-term, profitable operation for your next project. Please call or write our nearest office.



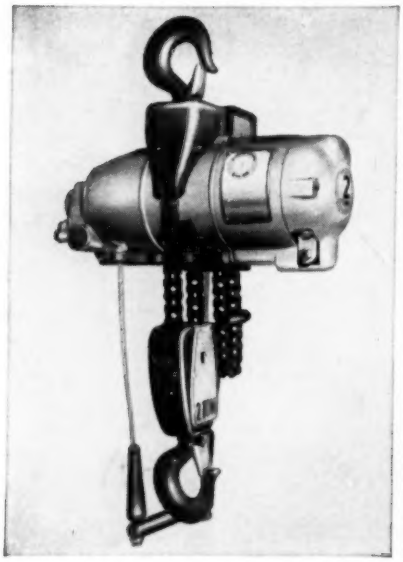
STONE & WEBSTER
ENGINEERING CORPORATION

Affiliated with STONE & WEBSTER ENGINEERING LIMITED (London)

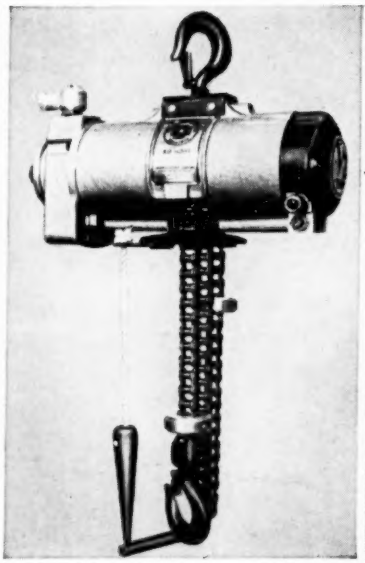
New York Boston Chicago Pittsburgh Houston
San Francisco Los Angeles Seattle Toronto

Air Hoists . . .
a complete line for loads to 4000 lb.

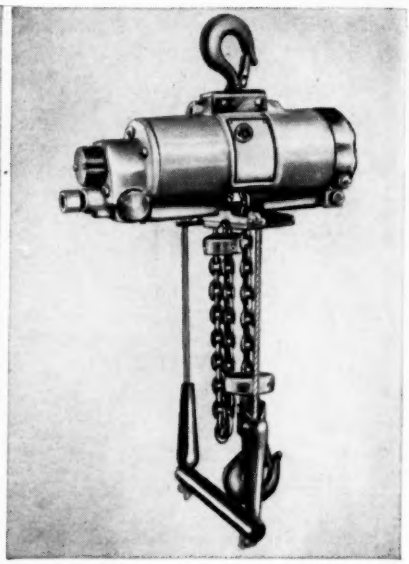
Get the lift, the power and the speed you need with *built-in safety*. Choose from Gardner-Denver's complete line of lightweight, easy-to-use air hoists. *Both piston and rotary types available.* With air power, you're assured of nonsparking operation. Air motors can't be damaged by overload stalls . . . can't burn out from continuous use. Motor is sealed from outside dirt, dust, moisture or corrosive fumes. Be sure your next hoist is a Gardner-Denver air hoist. Write for descriptive bulletins.



A heavy-duty hoist—The safe, sure lift you need for the heavy jobs with Gardner-Denver air hoists from 1000 to 4000 lb. Operator controls load with one hand . . . hoist does all the work.



A high-speed hoist—Combining lighter weight and higher speeds where fast lifts are of primary importance, Gardner-Denver rotary hoists are available in capacities of 1000 and 2000 lb.



A light lift—Handy, lightweight Gardner-Denver air hoists take the strain out of repetitive lifting . . . save time . . . cut operator fatigue. Capacities to 1000 lb.

Power on the beam—A time- and muscle-saving team, Gardner-Denver air hoist and "Hoistractor." Hoist lifts and lowers . . . "Hoistractor" moves hoist and load along the beam. Bulletin 87-1.

SPECIFICATIONS

Model	Capacity, lb.	Standard** lift, ft.	Speed, fpm	Weight, lb.	Bulletin No.
86-2V40	4000	8	10	100	86-1
86-2V20	2000	8	19	78	86-1
86R-20*	2000	8	20	30	86-71
86R-10*	1000	8	40	27	86-71
86-2V10	1000	8	38	78	86-1
86-1V10	1000	8	19	28	86-1
86-1V5A	500	8	38	28	86-1
86-1V3	300	8	80	28	86-1
86A-1*	150	8	45	14	86-1

*Rotary motor hoists—all others are axial-piston motor hoists.
**10-ft. lift optional.

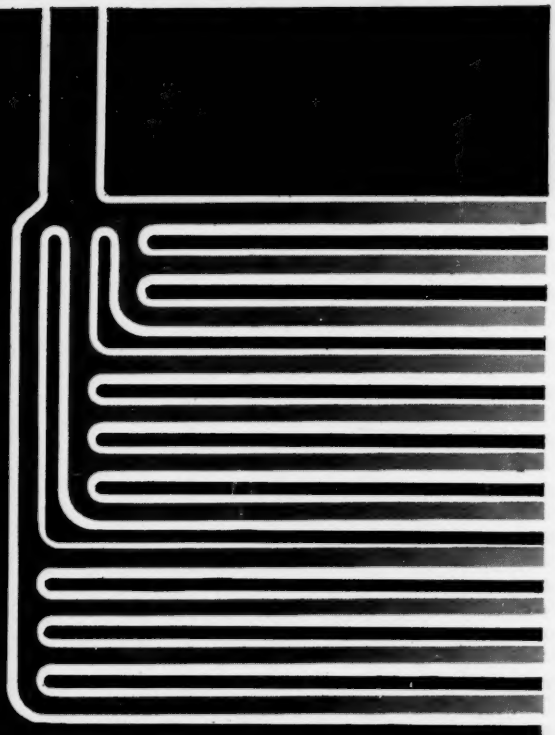
EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

GARDNER-DENVER

Gardner-Denver Company, Quincy, Illinois
In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Avenue, Toronto 16, Ontario

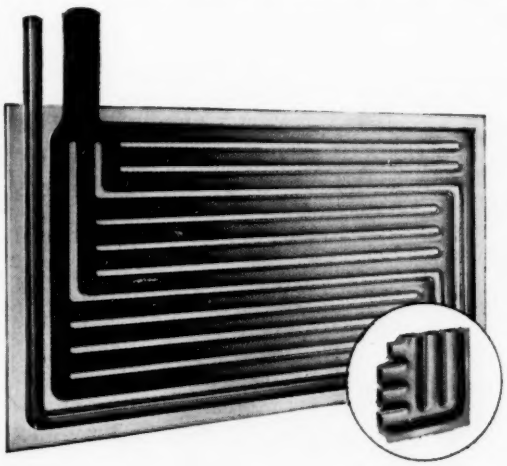
MULTI-ZONE PLATECOIL®

IS AN EXCLUSIVE TRANTER ADVANCEMENT IN HEAT TRANSFER TECHNOLOGY



The new MULTI-ZONE PLATECOIL introduces a new principle of coil design. The multiple header, multiple return pass arrangement produces FREE-FLO action. Steam is distributed to all levels of the coil almost instantaneously. This new design overcomes the problem of condensate "trapping" — a disadvantage of common pipe coils and single-headered units—that robs effective heat transfer area. Only TRANTER PLATECOIL offers the extra capacity of MULTI-ZONE heat distribution.

MULTI-ZONE PERFORMANCE SOLVES TOUGH TANK AND PROCESS HEATING PROBLEMS



Better steam distribution provides a reserve capacity for heat transfer to overcome overload conditions which drop tank and process vessel temperatures. Heat-up time after tank or processing equipment shut-down is cut to a minimum. Tank temperatures are maintained within closer limits and production is improved.

More effective heat transfer area and more heat transfer per square foot of area makes it possible to use fewer and more compact PLATECOIL units than is possible with other types of equipment. Valuable tank space is saved and the need for addition of new tanks to get higher production is often eliminated.

Add to these performance advantages, low cost of installation and operation, economical maintenance and scientific engineering for the best answer to your heat transfer problems.

Write for NEW Bulletin P61 for complete data.

Tranter Manufacturing, Inc.

LANSING 9, MICHIGAN

PLATECOIL® DIVISION

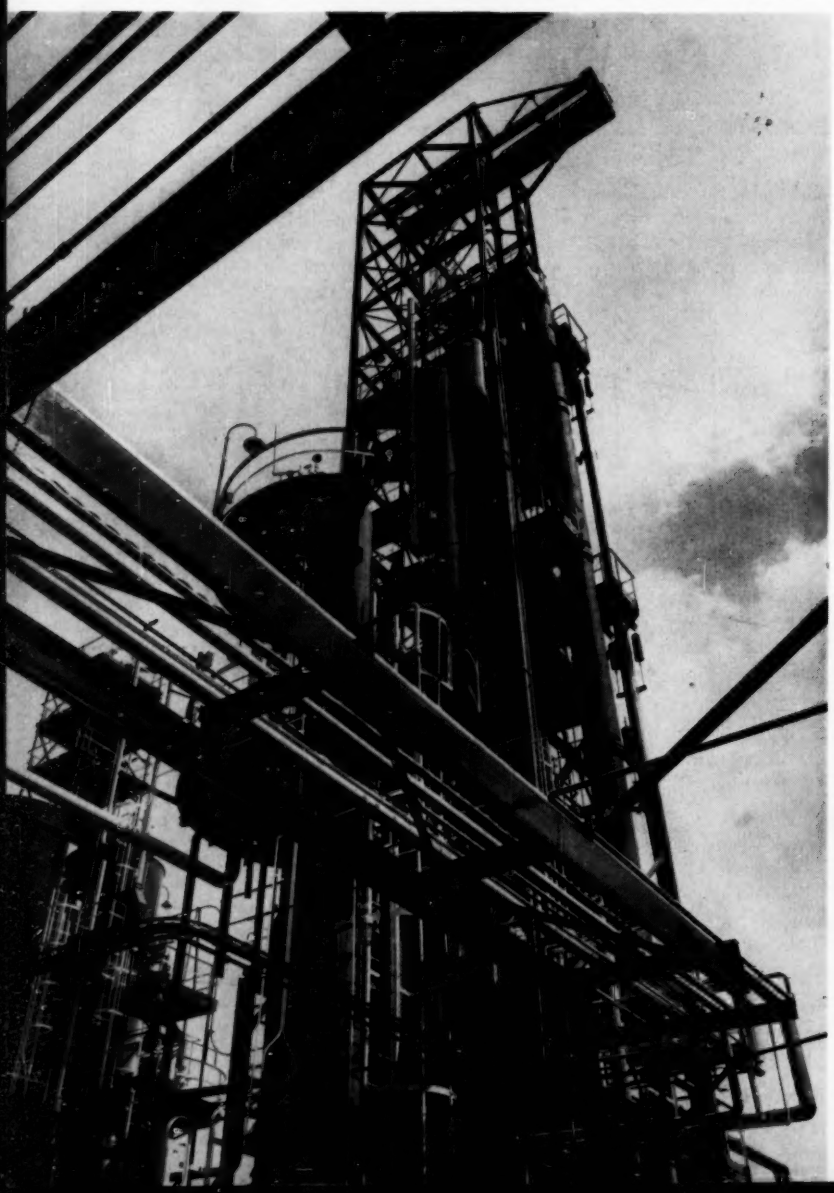
DEVELOPMENTS . . .

PROCESS FLOWSHEET

R. A. LABINE

New: Making Iron in a Fluidized Bed

FLUID-BED REDUCER towers over the rest of the new H-Iron plant.



Fluid-bed processing has again proved its versatility, this time in a brand new field: direct reduction of iron ore with hydrogen. Originally developed by Hydrocarbon Research and Bethlehem Steel Corp., the "H-Iron process" has come to commercial fruition in a $3.8-million, 50-ton/day plant of the Alan Wood Steel Co. at Conshohocken, Pa. The Alan Wood unit, now in preliminary operation, will produce a high quality iron powder for powder metallurgy applications.

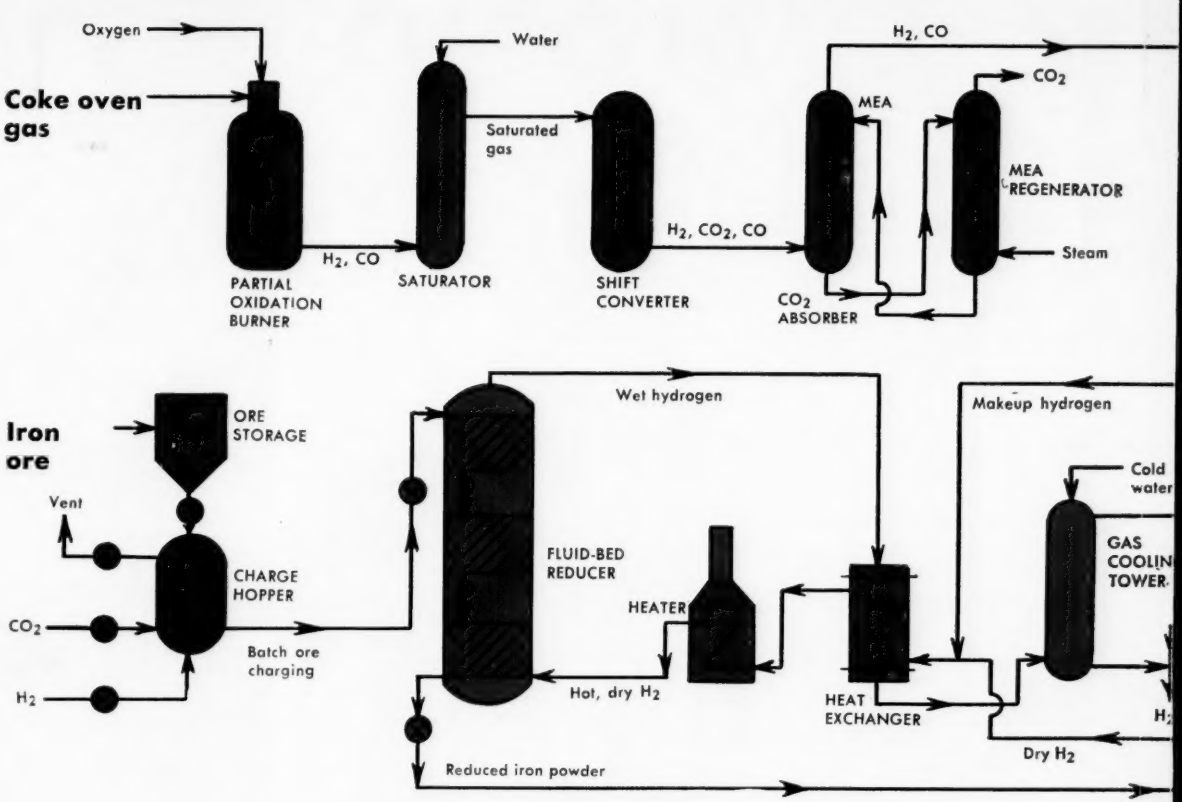
Distinguishing feature of the H-Iron process compared to other fluid-bed processes is the high operating pressure—about 500 psig.—which permits a high rate of reduction at low temperatures. (Temperature must be kept less than 1,000 F. in the reducer to prevent reduced iron particles from sintering together and sticking to the vessel.) This first commercial H-Iron installation was described recently by G. G. Karian of Alan Wood Steel at the Philadelphia regional technical meeting of the American Iron & Steel Institute.

Four sections make up the Alan Wood H-Iron plant: (1) ore preparation plant, (2) hydrogen production unit, (3) fluid-bed reducer, (4) powder finishing plant.

▶ **Heart of the Process** — The

Unfold Flowsheet

CHEMICAL ENGINEERING
FEBRUARY 8, 1960 • PAGES 96-99



fluid-bed reduction step, unlike the blast furnace, does not eliminate gangue from the charged ore, so the starting material must be nearly free of impurities to make high-quality iron powder.

Reducing vessel, made of carbon steel, is 5½ ft. I.D. and 94 ft. high, containing three fluidized beds. Three beds are required because of the decline in the rate of conversion as reduction proceeds. Hydrogen, contacting the finely divided ore powder, reacts according to the equation:

$$Fe_3O_4 + 4\,H_2 \longrightarrow 3\,Fe + 4\,H_2O$$

To charge the reducer, 15 tons of finely ground iron ore are delivered to the charge hopper. Hopper is sealed and purged of air with carbon dioxide—a byproduct of the hydrogen production unit. After purging, hopper is pressured with a hydrogen slipstream to 150 psi. higher than reducer pressure and ore is delivered to the top of the reducer through a 1½-in. pipe by opening the charge valve.

Before reducer can receive a batch of fresh ore, however, the 98% reduced iron must discharge from the third bed to the discharge hopper. Partly reduced ore (87%) on the second bed then falls by gravity through internal valves to the bottom bed and the least-reduced material (47%) in the top bed dumps to the second bed in similar fashion. During transfers the reduction vessel remains at full pressure with flow of hydrogen uninterrupted.

▶ **Recovering Hydrogen**—Approximately 5% of the hydrogen flowing through the reducer is converted to water by the reduction reaction. (It takes 20,000-22,000 cu. ft. of hydrogen to make a ton of iron powder.)

Wet effluent hydrogen from the reducer cools in a heat exchanger, then passes through a cooling tower. Cooled gas flows to a Freon chiller—a shell-and-tube exchanger—where the water condenses out, leaving the H_2O content of the hydrogen only a few hundredths of a per cent.

Combined stream of recycled and makeup hydrogen is preheated to about 700 F. in an exchanger, delivered to a hydrogen heater

where t
gas is t
▶ **Bewar**
reducer
to avoid
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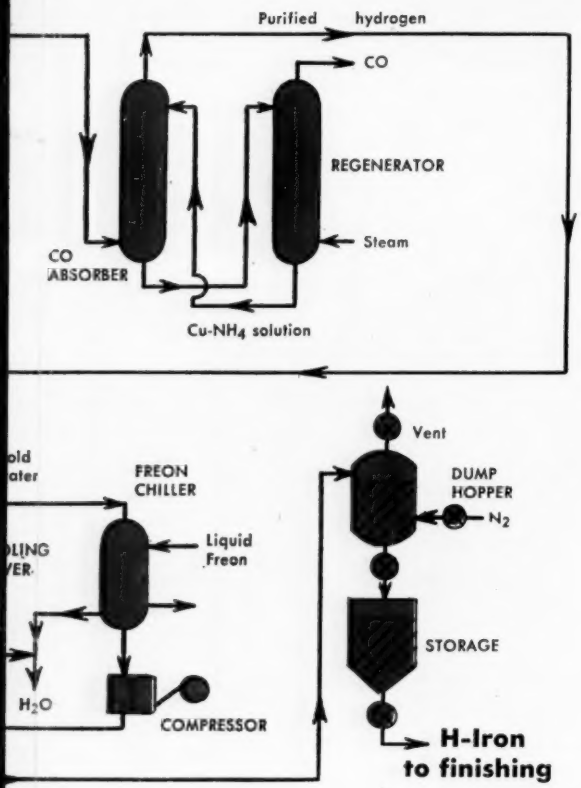
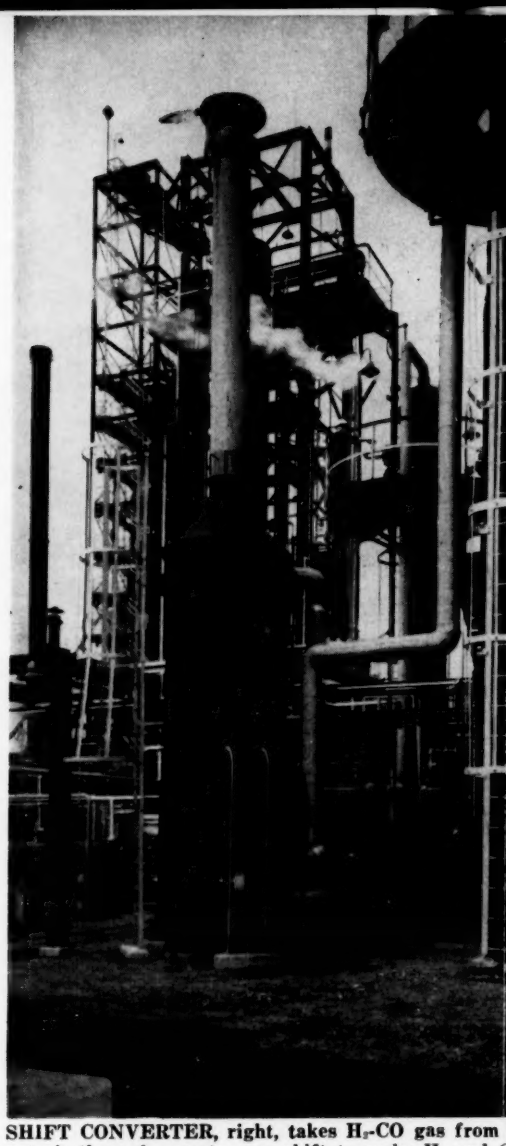




SHIFT CONVERTER, right, takes H_2-CO gas from puts it through a water-gas shift to make H_2 and

temperature is raised to 1,000 F. and then returned to the reducer.

Care of Air—H-Iron as it comes from the er is pyrophoric and care must be taken oid contact with air.

Discharge hopper containing the reduced powder is depressured and purged of gen with nitrogen—a byproduct of the n plant. H-Iron is then conveyed by gas re to a storage bin and is maintained a nitrogen atmosphere until ready for rocessing.

o produce nonpyrophoric powder for pplications as welding rods and cutting arfing powder, the H-Iron is heated to 1,600 F. in a nonoxidizing atmosphere.

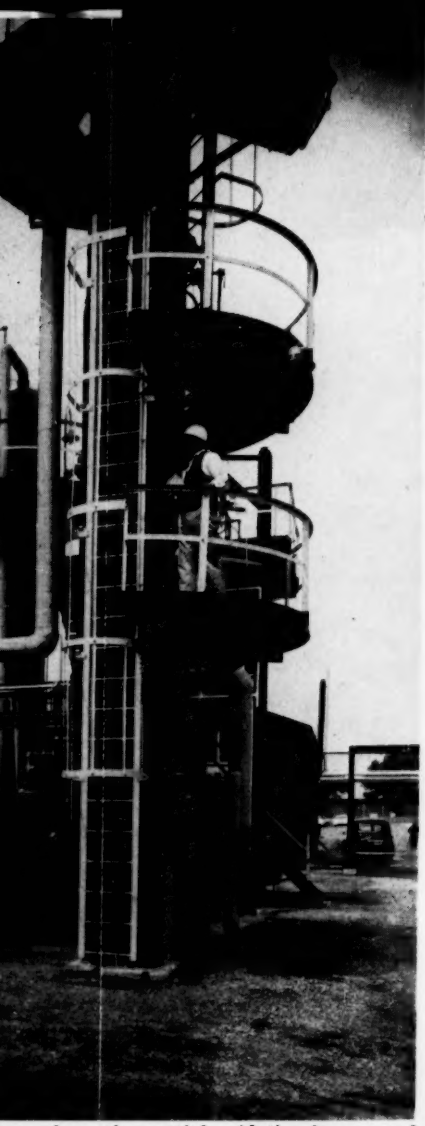
rogen Producing—Hydrogen for the re- reaction is produced by partial oxida- f coke oven gas which comes from coking operations. Production rate nts to about 1.2 million cu. ft./day of gen.

oke oven gas arrives at 3 psig., is com- d to 500 psig. and flows to the partial ion burner along with 500-psig., 98% oxygen. Hydrocarbons in the gas oxidize to hydrogen and carbon monoxide by carefully controlling reaction temperature. Effluent from the generator runs about 68% H_2 and 26% CO (dry basis).

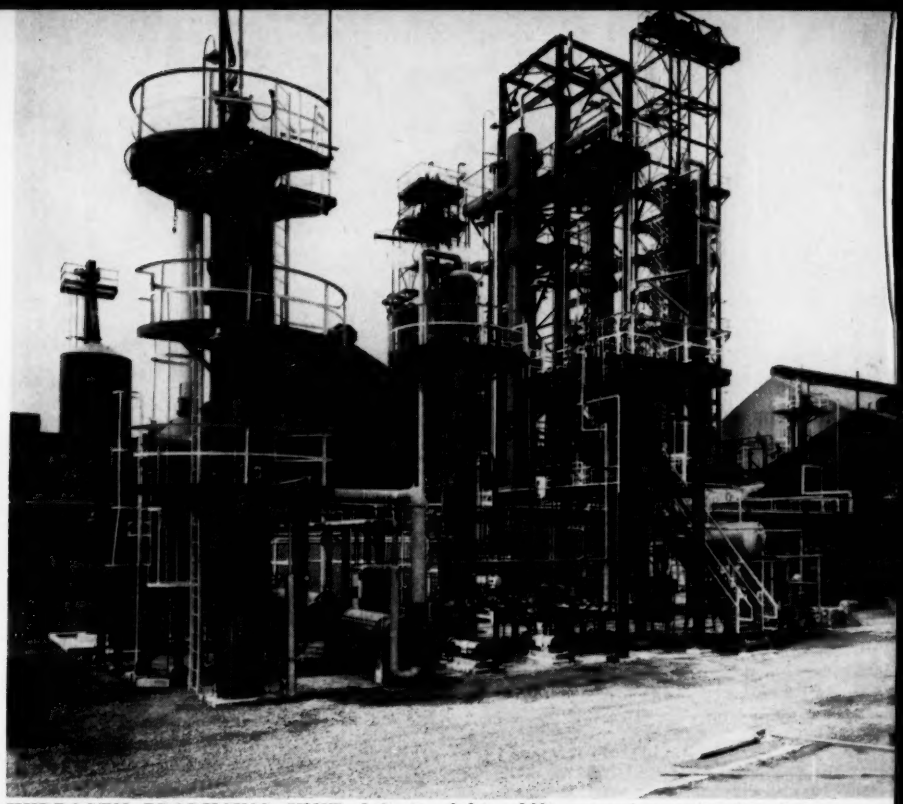
Gas passes through a saturator tower where countercurrent streams of water saturate gas with H_2O vapor. Saturated gas leaves the top of the tower and passes to the shift converter through a preheater which raises gas temperature to the proper reaction level. After conversion, the H_2-CO_2-CO stream passes to a two-stage scrubbing system where CO_2 and CO are removed. The CO is utilized for its heating value while the CO_2 is used for purging purposes. Final analysis of the hydrogen stream with traces of CH_4 and

▶ **Raw Materials**—Bulk the process comes from tite mine in northern Ne rial is uniquely suited because of its purity an which is essential for fl tite (Fe_3O_4) reduces mo bed reaction than he other common form of i

To make a ton of H- 1.4 tons of iron ore alo cu. ft. of hydrogen, 0.2 lb. of nitrogen plus stea electric power.

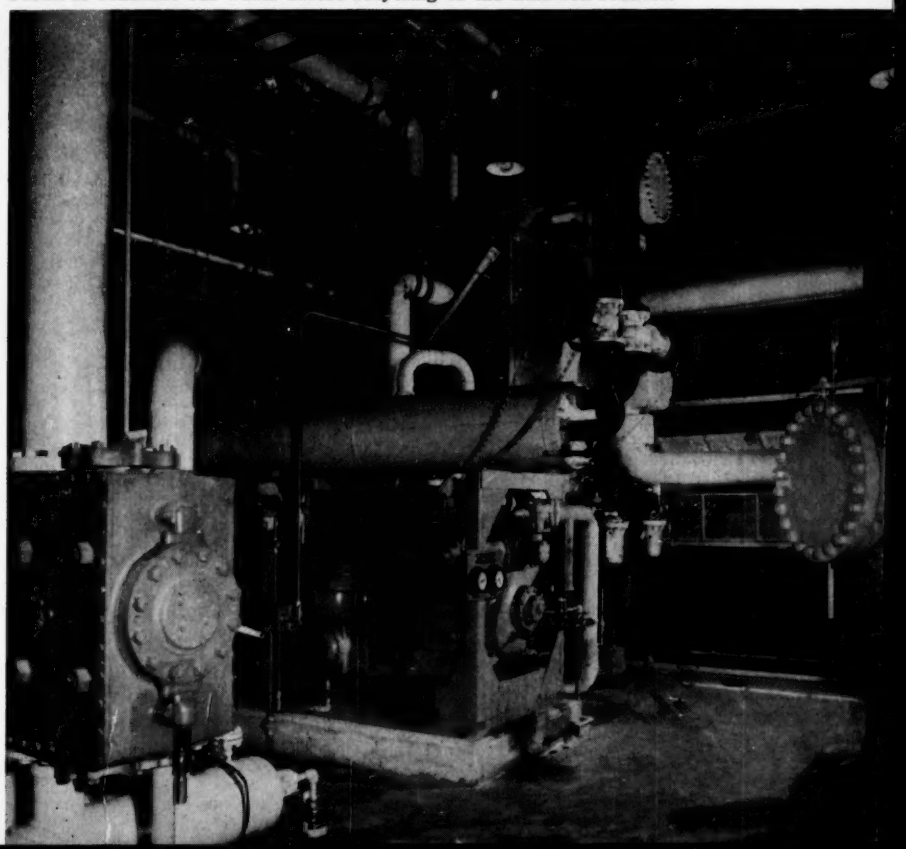


gas from the partial oxidation burner and
e H_2 and CO_2. Scrubbing removes the CO_2.



HYDROGEN PRODUCING UNIT, left to right: shift converter, saturator tower, partial oxidation generator. In the background are the scrubbing towers.

FREON CHILLER, a shell-and-tube exchanger, cools wet hydrogen gas against liquid Freon to condense out water before recycling to the fluid-bed reducer.



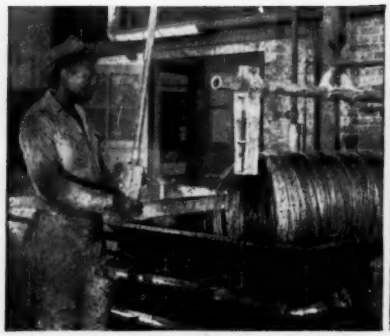
n stream runs 97% H_2, 3% N_2
CH_4 and CO.

ls—Bulk of the ore charged to
nes from Alan Wood's magne-
thern New Jersey. This mate-
suited to the H-Iron process
purity and fine particle size—
tial for fluidizing. Too, magne-
duces more readily in the fluid-
than hematite (Fe_2O_3), the
form of iron ore.

ton of H-Iron powder requires
ore along with 20,000-22,000
gen, 0.25 tons of oxygen, 100
plus steam, cooling water and

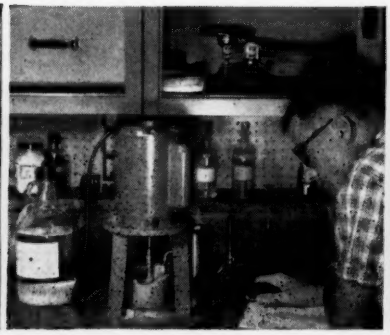
PUMPAGE

Goulds news about pumps for process industries



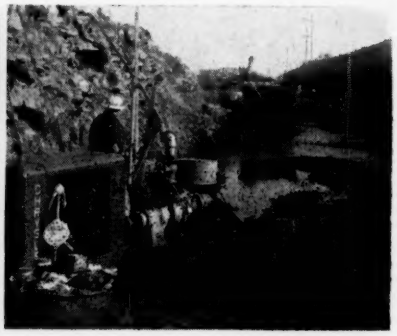
In and out of a pickle

One of the many steps in the manufacture of steel wire is the dunking of coils in a pickling solution. To clean the heavy wire, you need plenty of water *plus* a high-pressure spray—both adequately supplied at this plant by a Goulds Fig. 3330 pump. This four-inch, four-stage centrifugal, driven by a 50-hp motor, delivers approximately 200 gpm at a discharge pressure of 240 pounds, creating the pressure and capacity necessary to do the job effectively. Another Goulds pump supplies pressure for the spraying of coils of fine wire. Both pumps are operated at five-minute intervals throughout the day and have required just routine maintenance of the packing box since installation approximately five years ago.



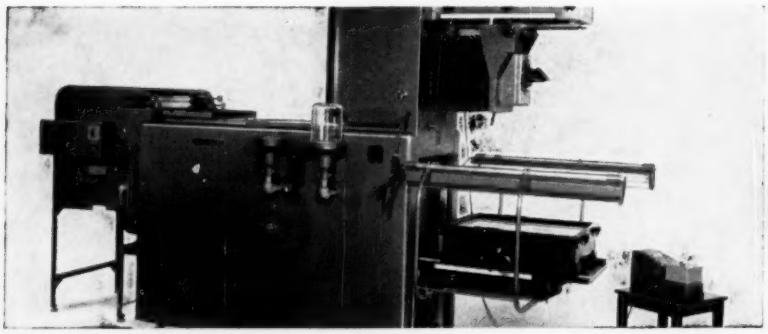
New test lab for you

How do you select the materials of construction for your chemical pump? Published materials-recommendation charts are generally based on static corrosion tests. These data, however, may be completely erroneous when applied to a centrifugal pump. The combinations of erosion from solids plus differential velocities and impingement with corrosion make selection difficult. Unless actual field experience is available, any recommendation involves guesswork. To minimize guesswork Goulds now offers the best substitute for field experience. A new Customers Products Test Lab is designed to provide answers on how a liquid will react inside your pump. Abrasion testers simulate actual conditions inside a pump. Results from these tests provide information to help solve corrosion problems.



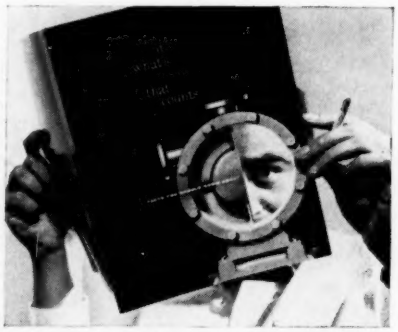
Emergency at Niagara Falls

Diversion conduits now under construction at Niagara Falls will take water from the Niagara River and convey it through and under the city to a new hydroelectric plant at Lewiston. During construction of the conduit's 300-foot descent through solid rock to Lewiston, ground water pockets were encountered that had to be drained before construction could continue. An emergency call came to Goulds: Could we help? Quick delivery of Goulds 3135 centrifugals saved the contractor many thousands of dollars in lost time; six more pumps were added as the need for greater capacity developed. Selected for ease of maintenance and ability to handle rugged solids, these process pumps solved this unusual application problem. Get the details by writing.



Small pump solves big problem for Photostat Corp.

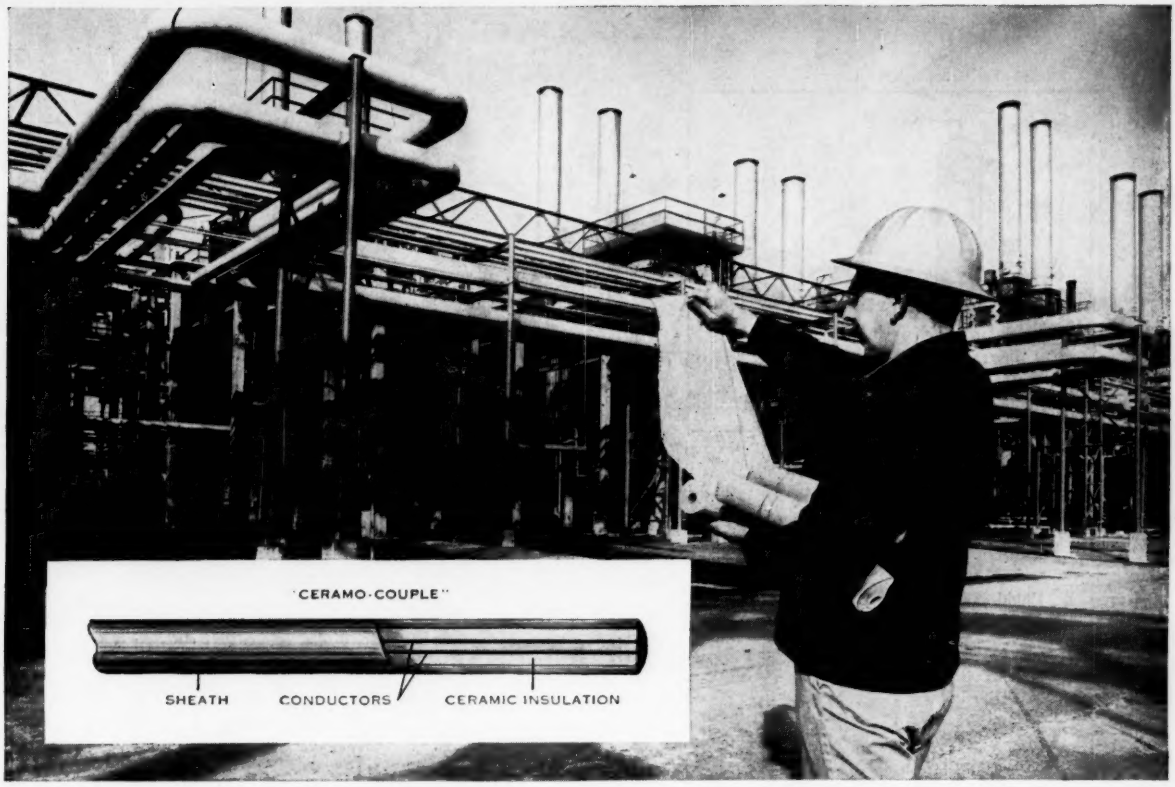
Builders of original equipment are finding that a Goulds process pump fits their requirements ideally. Dependability is imperative, for if the pump fails, the entire unit is out of service. Take, for instance, the case of Photostat Corporation. Inside a Photostat Copying Machine, the complete photographic process occurs automatically: the making of a negative plus developing, washing and drying operations. Because the developer solution must be circulated constantly, Photostat needed a compact pump that could reliably provide continuous service. We supplied the pump —Goulds Fig. 3604, a ¾" centrifugal with "big pump" stamina. Today hundreds of these pumps are in operation on new equipment and as replacements for older equipment. Have equipment that requires constant circulation of liquids? Write for Bulletin 725.6.



Inside the Goulds-Pfaudler pump

Inside this unusual booklet are facts you should know about a revolutionary answer to your corrosive-pumping problems. It's all about the Goulds-Pfaudler glassed pump, as the only pump of its kind. This booklet gives the answers to question after question, starting with "What is glassed metal?" and ending with "Is the glassed pump operated like any centrifugal pump?" Send for your free copy today. Goulds Pumps, Inc., Dept. CE-20, Seneca Falls, N. Y.

GOULDS GP PUMPS



Process engineer at Sun Oil Refinery examining temperature measurements from "Ceramo" thermocouples.

Ceramo® Thermocouples Help Sun Oil Prevent Furnace Tube Failure

Thermo Electric's Versatile "Ceramo" Solves Another Problem

The Sun Oil Company refinery at Marcus Hook, Pa., found the answer to a difficult problem—preventing tube failure in their process heaters—with T-E's "Ceramo-Couples."

As coking and scaling build up within these tubes, heat transfer is reduced and tube temperatures rise. Unchecked, this condition can eventually result in costly, unscheduled shutdowns and potentially dangerous tube rupture.

Sun Oil also had another problem—rapid thermocouple failure. To measure tube skin temperatures from 500—1200° F. and withstand furnace temperatures to 1800° F., they were using 8-gage, insulated, pencil-type T/C's without protection tubes. Wires became brittle and soon broke. Hot junctions separated from the tube wall and read gas instead of tube temperatures. Process engineers had no confidence in readings. Costly, time-consuming installation of new T/C's was needed after every furnace shut-down.

Sun Oil went looking for a better thermocouple. They found it in T-E's "Ceramo"—ceramic insulated conductors encased in overall metal sheathing. Their 3/16" O. D. "Ceramo-Couples" have 20-gage Chromel-Alumel conductors and stainless steel sheathing. Thermocouple life was greatly increased, replacement was cut in half. Reliable readings from "Ceramo" permitted operation of process heaters at higher temperatures—thereby increasing production. "Ceramo's" ability to be bent on a small radius without shorting or grounding simplified installation. And "Ceramo" flexed with the differential motion between tubes and furnace walls.

Sun Oil now has about 300 "Ceramo-Couples" in use at Marcus Hook in 5 to 32 ft. lengths. During the 5 years "Ceramo" has been in use, Sun Oil has had no furnace tube failure or unscheduled shut-downs from faulty temperature measurement.

If you have problems of high temperature, moisture, abrasion, corrosion or difficult installation, investigate T-E's "Ceramo." Only "Ceramo" has the quality of materials and construction to meet all these needs.

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SADDLE BROOK, NEW JERSEY
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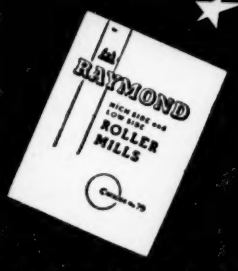

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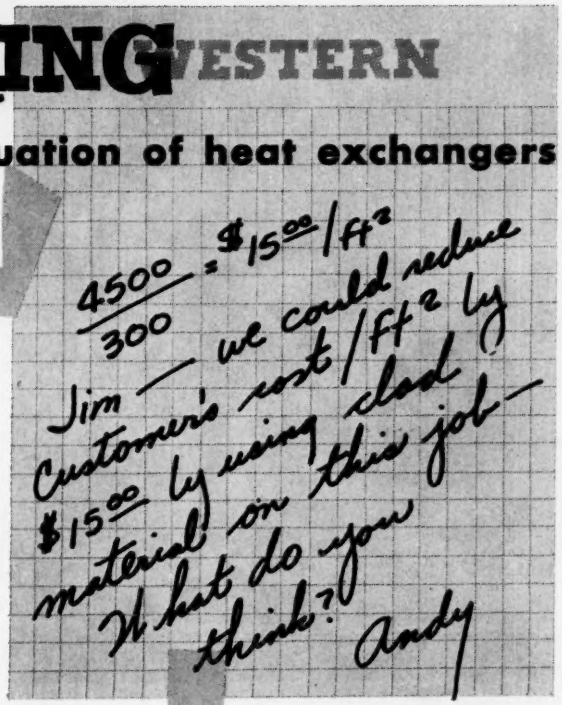

Recognizing the importance of accurate economic evaluation of capital equipment to our customers' profit structures, Western's engineers have for many years applied cost-engineering principles to the design and fabrication of all Western Heat Exchangers.

This has special significance in continuous flow processes, where operations never cease and where operational and maintenance economies often spell the difference between profit and loss.

With an intimate knowledge of heat transfer technology as well as process operating conditions, Western has often been able to aid in such evaluation and long-range economy by suggesting short-cuts and improvements, while yet maintaining the efficiency and quality for which Western Heat Exchangers have gained respect.

Western's engineering staff takes professional pride in the accuracy of their evaluations, and they can be of great benefit to your own cost engineers when heat transfer is a factor in your process developments. Why not put them to the test?

WESTERN'S STAKE IN YOUR FUTURE

. . . is in the young engineers who are interested in the specialty of "cost-engineering" in heat transfer economics. To stimulate such thought, another of Western's "personal-professional-advancement" messages, partially shown at right, currently appears in several trade journals. A more complete treatment of the subject is available in pamphlet form, singly or in quantity, upon request.

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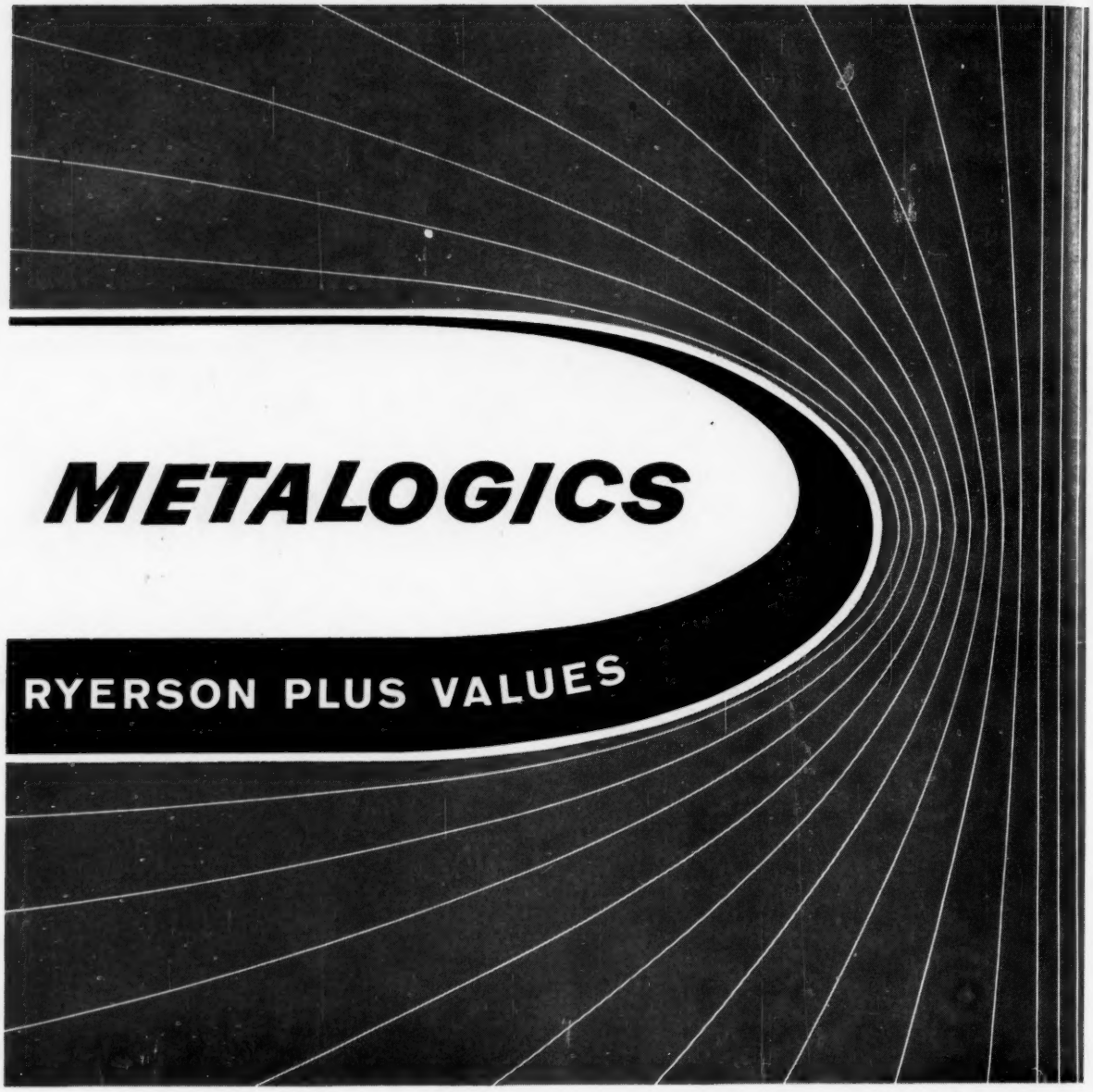
Design Economics of Heat Exchangers Furnish Basis for Heat Transfer Cost Engineering

The application of cost engineering practices in the accurate evaluation of capital equipment in the process industry is rapidly becoming more and more vital to the management of process companies, as margins of profit grow narrower.



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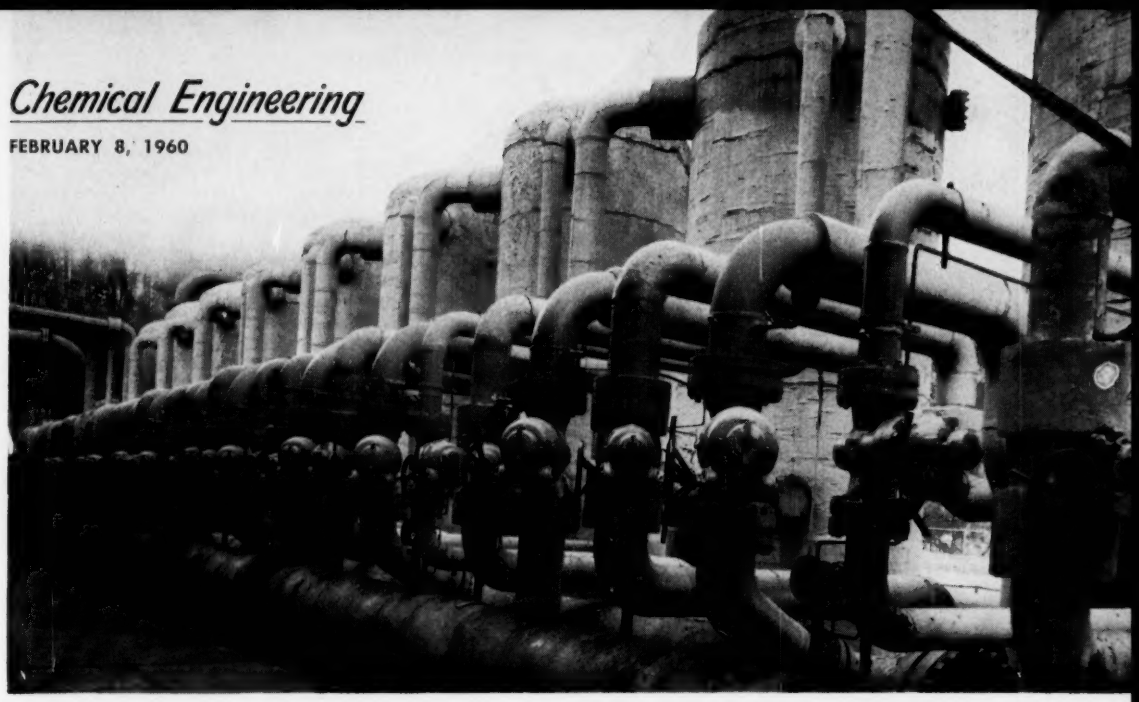
Chemical Engineering
FEBRUARY 8, 1960



New Developments Boost an Up-and-Coming Unit Operation:

Fixed-Bed Adsorption

Improved designs and calculation methods, new materials put adsorption in the same class technically and economically as distillation, extraction and absorption for the separation of chemicals.

H. M. Barry
Linde Co.
Division of Union Carbide Corp.
New York

MUCH has happened in the last few years to dispel an old notion: Adsorption cannot compete with other separation techniques when handling streams containing high-impurity concentrations.

You may have read that adsorption is good only for removing trace quantities of impurities; adsorption is used mostly for gas drying and solvent recovery; that fixed-bed systems cannot hope to compete with what are essentially continuous operations like distillation and absorption; you may feel that extensive laboratory testing programs would be required to get the necessary design data, or that adequate all-purpose design procedures are unavailable. None of these statements is exactly true.

We hope this Report stimulates new interest in this unit operation. We will also discuss some of the places where adsorption has already proved its worth. Then we will take a short tour through the realms of process fundamentals—what you have to know about adsorption theory, equilibrium and kinetic data, cycles, equipment design and the like. Finally, we will show why the economics of adsorption systems is often attractive when compared with other separation processes.

For example, it has been the contention for many years that the use of fixed-bed adsorption systems is restricted to removal of small percentages (in the order of 10% to 1% or less) of adsorbate from a

stream. Recent developments in the hydrocarbon separation area[5, 8, 9] show that properly designed fixed-bed adsorption systems can compete with unit operations such as distillation, in separating streams where absorbate concentration may run as high as 50% or more.

Of course, such systems involve radically new designs and regeneration schemes. If these new systems do nothing else they point out clearly that adsorption is about to advance rapidly and take its place among the more mature and sophisticated operations familiar to the engineer.

Adsorption Proves Its Worth

Adsorption systems are not new; they are found in the chemical and petroleum industry, and in such fields as aviation, electronics, food packaging. The typical activated-carbon solvent-recovery system is an integral part of many processes. Mantell[15] reports that in 1950 acetate rayon producers in North America were recovering over 600,000,000 lb. of acetone annually, by adsorption, valued at approximately $50-million. By 1959 the figure had reached approximately 1-billion lb./yr. of solvent recovered in acetate rayon processing alone. Another 700-million lb. of solvent is recovered by cellophane manufacturers.

The production and sale of adsorbents is big business. We cannot offer a figure for the total number of pounds of adsorbent in use in the United States. The problem is difficult because of the wide assortment of adsorbents and the wide variety of uses to which they are put. Mantell even includes ion-exchange materials in his classification of adsorbents. In the gas drying area alone, for 1957, there was an adsorbent inventory of approximately 20-million lb. of which about 7-million lb. was being used in the natural-gas industry. It

Important Commercial Adsorptive Separations—Table I

Water From Gases	Water From Liquids	Miscellaneous Separations and Purifications	
		Material Adsorbed	From
Acetylene	Acetone	Acetylene	Liquid oxygen
Air	Acetonitrile	Ammonia	Cracked ammonia
Argon	Acrylonitrile	Ammonia	Reformer hydrogen
Carbon dioxide	Allyl chloride	2-Butyne	Isoprene
Chlorine	Benzene	Carbon dioxide	Ethylene
Cracked gas	Butadiene	Carbon dioxide	Air
Ethylene	n-Butane	Carbon dioxide	Inert atmospheres
Helium	Butene	Carbon monoxide, methane	Hydrogen
Hydrogen	Butyl acetate	Compressor oil	Many kinds of gases
Hydrogen chloride	Carbon tetrachloride		
Hydrogen sulfide	Cydohexane	Cydic hydrocarbons	Naphthenes and paraffins
Natural gas	Dichloroethylene	Ethanol	Diethyl ether
Nitrogen	Di-methyl sulfoxide	Gasoline components	Natural gas
Oxygen	Ethanol	Hydrogen sulfide	LPG
Reformer hydrogen	Ethylene dibromide	Hydrogen sulfide	Natural gas
Sulfur hexafluoride	Ethylene dichloride	Hydrogen sulfide	Reformer hydrogen
	No. 2 fuel oil	Krypton	Hydrogen
	n-Heptane	Mercaptans	Propane
	n-Hexane	Methanol	Diethyl ether
	Isoprene	Methylene chloride	Refrigerant 114
	Isopropanol	Nitrogen	Hydrogen
	Jet fuel	NO, NO_2, N_2O	Nitrogen
	LPG	Oil vapor	Compressed gases
	Methyl chloride	Oxygen	Argon
	Methyl ethyl ketone	Unsaturates	Diethyl ether
	Mixed xylenes		
	Naphtha		
	Oxygen		
	n-Pentane		
	Perchloroethylene		
	Phenol		
	Propane		
	n-Propanol		
	Propylene		
	Propylene dichloride		
	Styrene		
	Toluene		
	Transformer oil		
	Trichloroethylene		

is not improbable that the total of all adsorbents in use runs into hundreds of millions of pounds.

It would be impossible here to discuss in detail the many uses and differing technologies for each adsorbent. It would be necessary to cover such things as treating petroleum stocks with clays; decolorizing with carbons; recovering solvents with carbons; dehydrating gases and liquids with silica gels, activated aluminas and molecular sieves, and many other recent uses, including improving gasoline stocks.

Fixed-Bed Most Successful

From a mechanical viewpoint adsorption can be carried out in several ways. For example, adsorbents are sometimes dumped into the fluid to be purified and later filtered out when exhausted; adsorbents are used in moving beds in a continuous operation, the most famous example of this is Union Oil's Hypersorption Process which uses carbon and was originally designed to recover light hydrocarbons; finally, and probably most frequently, adsorbents are used in stationary or fixed beds, where the operation has been classified[17] as semi-continuous.

Most adsorbents are limited by their physical properties to use in fixed beds. And since simple but adequate design and scaleup procedures are not to be found in the chemical-engineering literature, we are going to review some of the fundamentals of fixed-bed adsorption technology.

First, however, Table I gives an idea of the range of uses for which fixed-bed adsorption is at present being employed in industry. The list is far from complete. Many companies install adsorption systems for separations they develop in their own laboratories and plants and never publicize. Of course, adsorbent manufacturers are aware of many other separation processes which they develop cooperatively but on a confidential basis with their customers. It ought to be pointed out that an engineer who refuses to consider adsorption because he is unaware of a successful operating installation may be doing a disservice to himself and those who employ him. This powerful separation operation is far too often overlooked.

Table I lists only separations which have been commercialized. Literally hundreds of other separations have been reported in the literature as having been successfully performed in the laboratory. Many of these surely can and will be commercialized as chemical engineers become more familiar with adsorption.

Tour of Adsorption Fundamentals

Practical information on how equilibrium and kinetic data can be used for evaluating and designing adsorption systems, including the novel mass transfer approach.

Adsorption is a physical phenomenon which occurs when gas or liquid molecules are brought into contact with a solid surface.

Some of the molecules will condense on the surface. If interaction between solid and condensed molecule is relatively weak, the process is called physical adsorption, due mainly to Van der Waal forces. Sometimes interaction is quite strong and similar to a chemical reaction. This case is referred to as chemisorption or activated adsorption. We are primarily interested in this Report with physical adsorption, but both kinds can occasionally occur in the same system. An example of such a case is the adsorption of oxygen on charcoal —physical at low temperatures and chemical at high temperatures.[15]

What Goes On In Adsorption

Equilibrium adsorption is, in many ways, analogous to other systems. Picture a small section of adsorbent surface. As soon as molecules are admitted some condense on the surface. A typical molecule will reside on the adsorbent for some finite time before it acquires sufficient energy to leave. Given sufficient time, an equilibrium state will be reached: number of molecules leaving the surface will just equal the number arriving.

The number of molecules on the surface is a function of (1) nature of the adsorbent, (2) nature of the molecule being adsorbed (the adsorbate), (3) temperature of the system, and (4) concentration of the adsorbate over the adsorbent surface.

- Nature of the adsorbent. The reader is referred to the literature[1, 2, 5, 15] for a detailed description. In general, it can be said the nature of the solid's chemical composition and its surface configuration affect the kinds of molecules it will selectively adsorb.
- Nature of the molecule being adsorbed. Such properties as boiling point, molecular weight, configuration, degree of polarity or polarizability, and degree of unsaturation (if a carbon compound) help to determine whether a molecule will adsorb on a solid.
- Temperature of the system. In general, a higher temperature means less material adsorbed or a shorter residence time on the surface.
- Concentration of the adsorbate. A higher concentration of adsorbate above the adsorbent surface means more molecules will be adsorbed.

Some of these effects can be examined by looking at the various equilibrium data plots which will be discussed later.

Several theories have been proposed to explain the adsorption phenomenon. The various theories lead to

equations which describe equilibrium state of the adsorption system. Theoretical models on which the theories are based include (1) a solid surface on which there is a monomolecular layer of molecules, (2) a multi-molecular layer, (3) capillary condensation; and others. Obviously, none of the present theories is either completely correct or incorrect, for the equations each adequately describe the adsorption isotherm for some systems over specific ranges—but no one equation can be applied to all adsorption systems.

Although it is most helpful to be able to describe equilibrium data in equation form for inclusion in more complex design equations, it is not absolutely essential. With some adsorbents it is possible to approximate parts of the isotherm with linear equations of the form $y = mx + b$. In fact this assumption is frequently made in developing analytical solutions for the case of moving-bed adsorbers.[13]

In any event, the design engineer need not be completely conversant with the many proposed theories of adsorption. A great deal of adsorption equilibrium data (especially single-component data) have been published. Data are relatively easy to obtain, if not available in the literature or from the manufacturer.

Some Commercially Important Adsorbents

Almost all known solids have some ability to adsorb. Relatively few are commercially important. Some of the qualities which make a solid a commercially important adsorbent are:

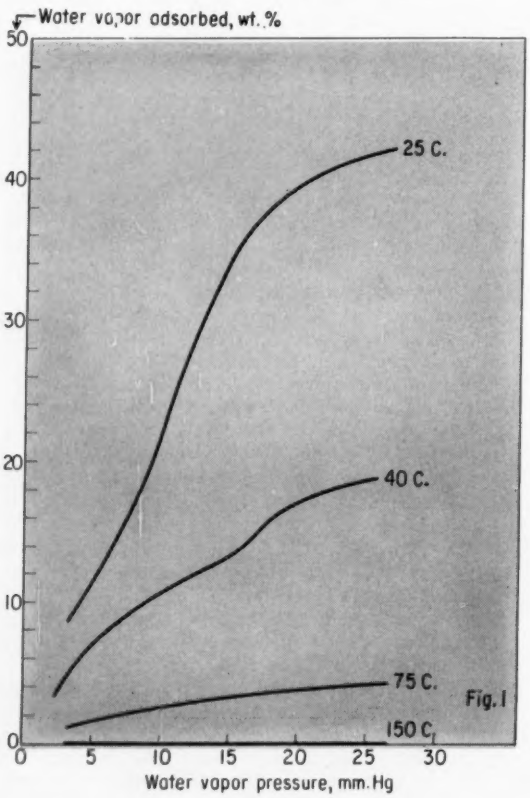
- Available in large quantity.
- High capacity for the gases and liquids to be adsorbed.
- High selectivity.
- Ability to reduce the material to be adsorbed to a low concentration.
- Ability to be regenerated and used again.
- Physical strength.
- Chemical inertness.

Adsorbents vary in the extent to which they possess each of these qualities, just as adsorbents vary in the uses to which they may be put. Some adsorbents are more suited to adsorption of hydrocarbon materials, others to adsorption of polar molecules (water and alcohols). Some adsorbents are so widely used for removing water from both gases and liquids that they are more often referred to as desiccants.

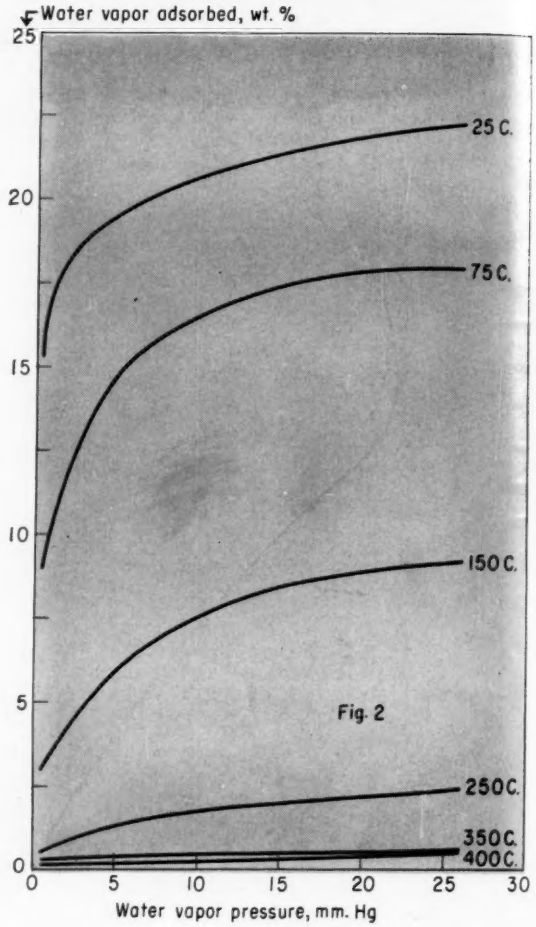
The most important adsorbents used in fixed-bed adsorption systems are:

- Activated carbon.
- Aluminum oxide.

Isotherms: Silica Gel Picks Up Water



Isotherms: Molecular Sieve Type 5A



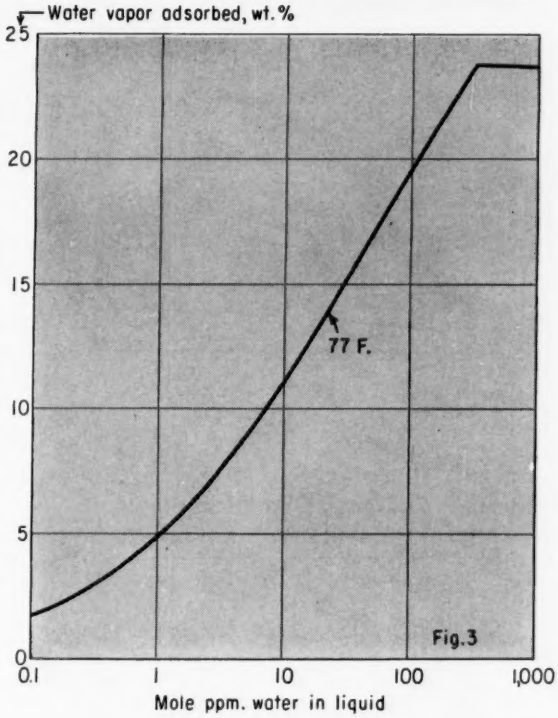
- Molecular sieves.
- Silica gel.

Activated carbon can be produced from a wide range of materials including many kinds of wood, bone, blood, coconut shells, etc. It is supplied commercially in the widest range of types. Many manufacturing processes are possible. In general, they involve releasing free carbon from its compounds using a sufficiently high temperature (600-700 C.). If the temperatures are too high the carbon produced will be inactive. U. S. manufacturers include Barnebey-Cheney Engineering Co., Pittsburgh Coke & Chemical, and Union Carbide.

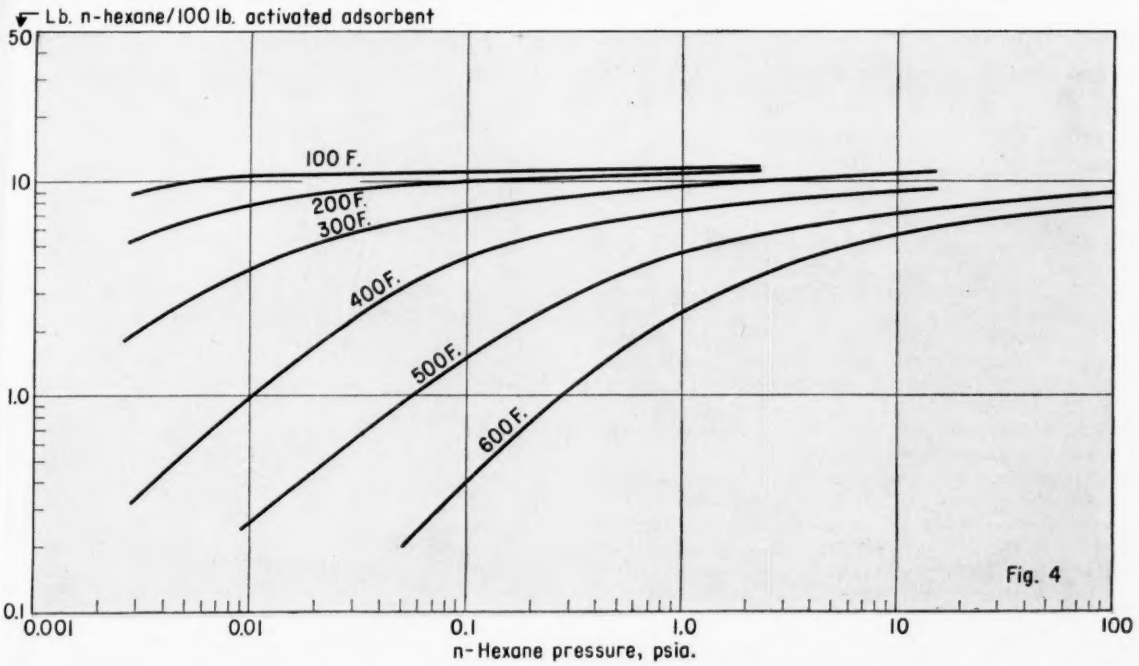
Aluminum oxide materials are made by activating bauxite (trihydrate bauxites or alumina trihydrate) by thermal processing to produce a highly porous, amorphous aluminum oxide. Besides the name bauxite, aluminum oxide adsorbents are also called activated alumina when manufactured under U. S. Patents 1,868,869 and 2,015,593. The material produced by Floridin Co., Inc., is called Florite. Names of other manufacturers can be found in standard references.

Molecular sieves are synthetic sodium or calcium alumino-silicate zeolite adsorbents. They differ from other commercial adsorbents since they are crystalline rather than amorphous and have pore openings of fixed and uniform dimensions. Adsorption occurs inside cavities to which the pore openings lead. Several types and particle sizes are available. (For a description of the manufacturing process see Ref. 14). Molecular sieves are manufactured by Linde Co., Division of Union Carbide Corp., under U. S. Patents 2,882,243 and 2,882,244.

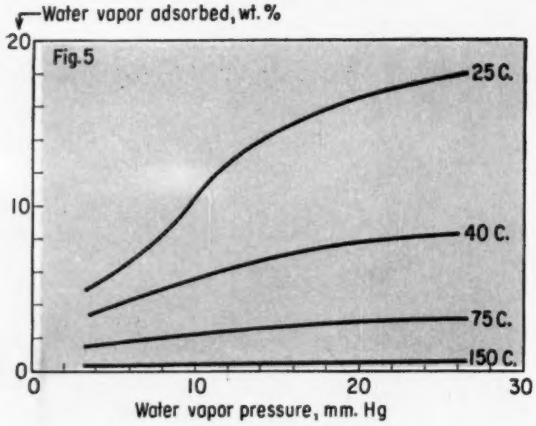
Isotherms: Molecular Sieve Type 4A (Liquid)



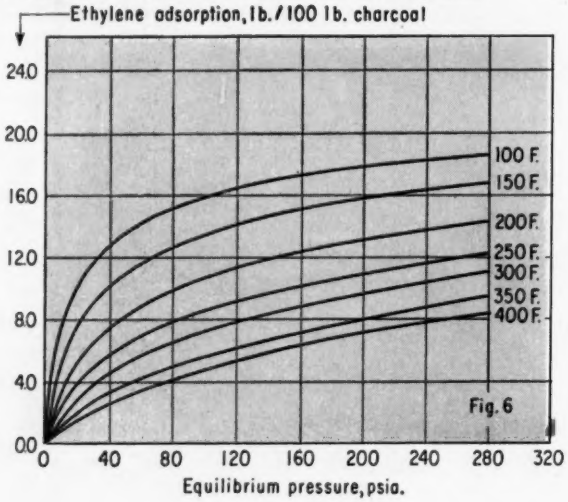
Isotherms: Typical for Hexane (Type 5A Molecular Sieve)



Isotherms: Activated Alumina Data



Isotherms: Charcoal Good for Ethylene



Silica gel is manufactured from silicic acid. The term "gel" is somewhat misleading since the material when ready for use is hard and glasslike. During one of the manufacturing stages it is precipitated from a colloidal solution of silicic acid, hence its name.[15] Commercial manufacturers include Davison Chemical and Culligan Zeolite. Socony Mobil Oil produces a special form of silica gel called Mobilbead.

Although carbons and silica gels are commercially available, researchers will occasionally prepare their own materials. Since performance of these adsorbents depends to some extent on the manufacturing procedure, some care should be exercised in using data reported in the literature. It is usually wise to check with the manufacturer if there is any doubt about the type and source of the material on which test data were obtained.

Another point which should be borne in mind when reading about adsorbents: some researchers will attempt to compare adsorbents by means of surface area measurements. Due to their porous nature all the materials discussed above have large surface areas compared to ordinary solids. Other than to distinguish adsorbents as a class from other solids, surface area measurements are rather meaningless. The way to compare adsorbents will be discussed in some of the following sections of this Report.

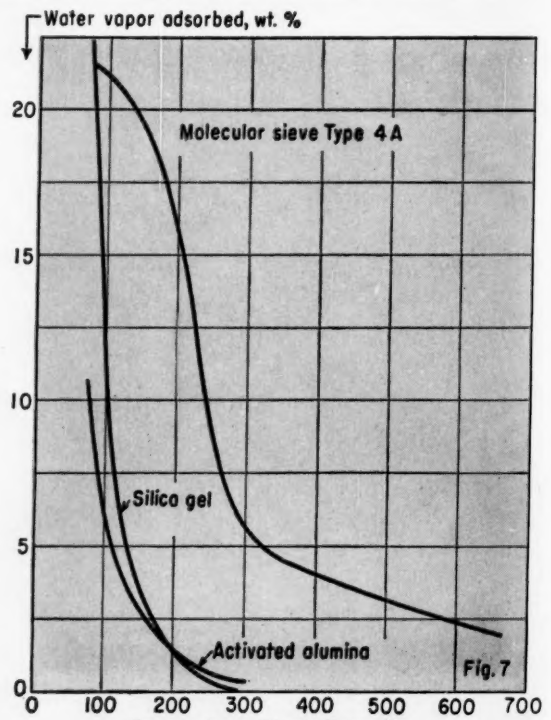
Single-Component Equilibrium Data

If adsorption is to be considered for a particular separation the first question that must be answered is what adsorbent shows the greatest capacity for the adsorbate. Equilibrium data alone will not completely answer the question, since the system in which it is to be used in a dynamic one. But it's usually most convenient to compare capacity of various adsorbents at the temperature and concentration at which the adsorbate is found in the process stream to be purified. Test equipment for determining equilibrium data is available.[19]

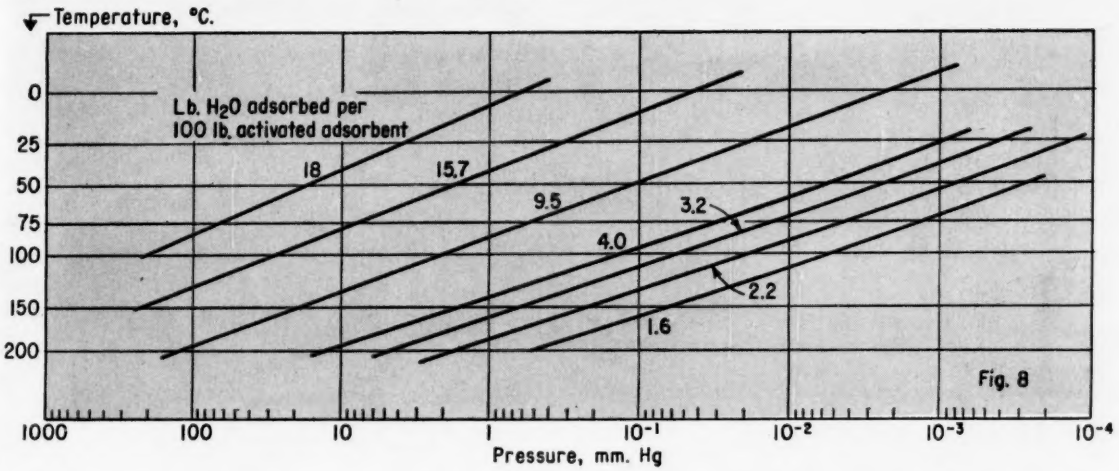
Complete equilibrium data will also show to what level the impurity theoretically can be reduced.

No final choice should be made at this point. Frequently two or more adsorbents will be found which exhibit reasonably good capacity and purifying ability when allowed sufficient time to come to equilibrium. It will be seen later that rate data can sometimes

Isobars: Adsorption at Constant Pressure



Isoteres: Constant Loading for Type 5A Molecular Sieves



invert the order of performance of the various adsorbents.

A great deal of single-component equilibrium data come in the form of isotherms which are plots of capacity of the adsorbent as a function of concentration at constant temperature. Such plots can be prepared on linear or logarithmic papers. Figs. 1 through 6* are typical curves (wt. % adsorbed is defined as lb. of material adsorbed on 100 lb. of dry adsorbent).

Data may be replotted at constant pressure in which case the plots are called isobars (Fig. 7). Constant loading plots are called isosteres (Fig. 8). In addition to simply recording equilibrium data, the isostere can be used to calculate heats of adsorption by applying the adsorption analog of the Clapeyron-Clausius equation.

$$\left[\frac{d\,(\log P)}{d\,(1/T)}\right] = \frac{\Delta H_{iso}}{2.30\,C}$$

where

P = partial pressure, psia.
T = temperature, °R.
ΔH_{iso} = isosteric (differential) heat of adsorption, Btu./lb.
C = gas constant, 1.987, Btu/lb. mole/°R.

The slope of the isostere is

$$\frac{T_1 T_2 \log (P_1/P_2)}{T_2 - T_1}$$

and has units of °R.

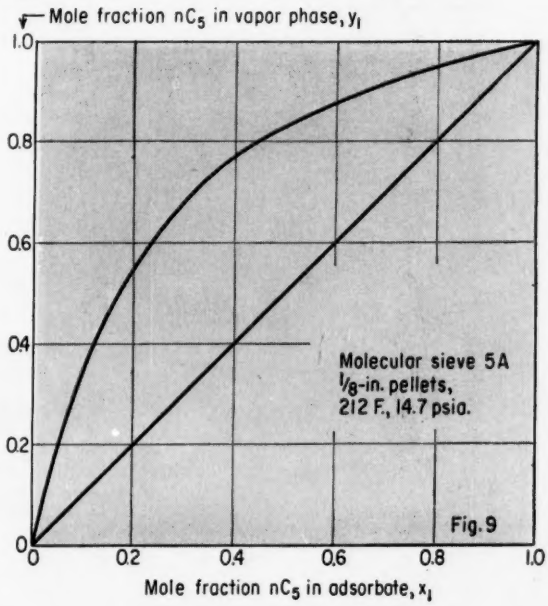
From a plot of log P versus $1/T$ slope is determined, multiplied by 2.30 C and divided by the molecular weight, which gives the isosteric or differential heat of adsorption in Btu./lb. of adsorbate. A plot of isosteric heat versus loading is then made. Graphical integration of the curve thus developed between the two loadings gives the isothermal integral heat of adsorption.

Amount of heat released can reduce the adsorbent's capacity unless isothermal conditions are maintained in the adsorption system. Most fixed-bed adsorption systems do not provide for isothermal operation. Consequently, sensitivity to temperature increases must be examined and allowed for in design whenever an appreciable temperature increase is expected.

Multicomponent Equilibrium Data

Unfortunately, multicomponent equilibrium data are not to be found as readily as single-component data.

Equilibrium Data Similar to Distillation



* Note that data in Fig. 3 can be used for all liquids which are not adsorbed on Type 4A and in which water is not completely miscible.

Systems reported in the literature are usually binary systems. The data are frequently plotted on the familiar x-y diagram. From this plot relative adsorptivities can be calculated in a fashion analogous to that used in distillation by means of the relationship (Fig. 9):

$$\alpha = \frac{y_1 x_2}{y_2 x_1}$$

where subscript 1 may refer to the mole fraction of the more strongly adsorbed component or to the less strongly adsorbed component.

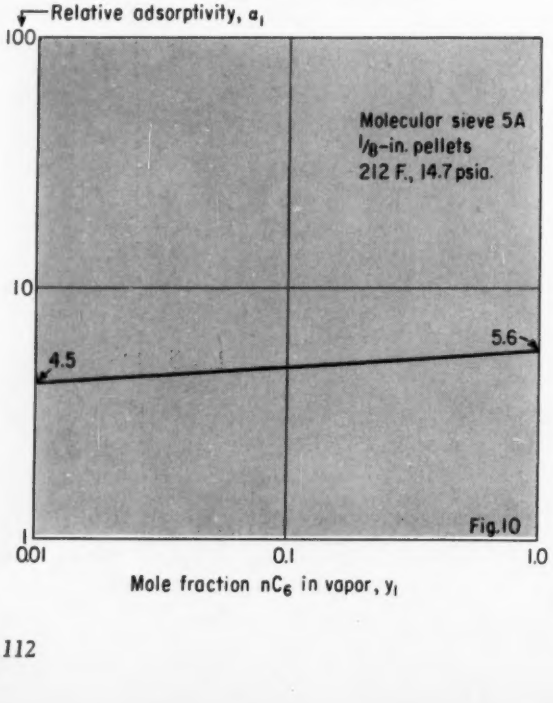
A consistent use of terminology, adopted by some workers in the field, is to call α relative volatility when y_1 refers to the less strongly adsorbed component in the vapor phase and call α relative adsorptivity when y_1 refers to the more strongly adsorbed component. Usage in the literature, however, is not consistent and care should be exercised in using such data.

Calculating Total Capacity

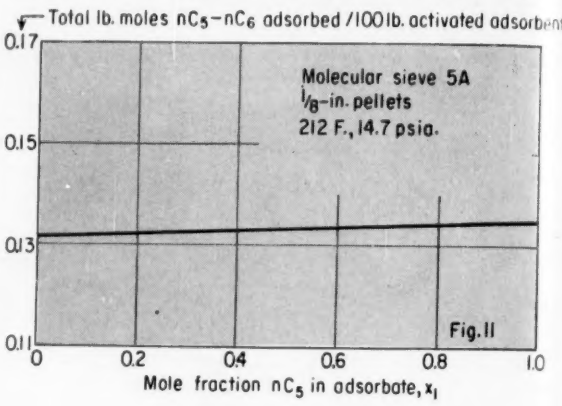
Together with relative adsorptivity data one also needs to know the total capacity of the adsorbent as a function of concentration. Fig. 11 is a plot of capacity versus concentration for a typical binary system. When such data are unavailable, a linear approximation can be made by plotting capacity for the two pure components at either end of the concentration axis and linearly interpolating between these two capacities.

On all molecular-sieve binary-equilibrium systems studied to date it has been found that a linear relationship exists between log α and the log of the vapor phase concentration of the more strongly adsorbed component (Fig. 10). This relationship permits extrapolation to concentration ranges where it is almost impossible to obtain accurate analyses.

Equilibrium Data Yield Adsorptivity



Capacity of Adsorbent Important in Design



Another technique for handling multicomponent equilibrium data has been used successfully by Kapfer[12] in predicting hydrocarbon equilibrium data on Columbia grade L carbon. It is known as the modified Polanyi theory or adsorption potential theory and is described fully in Ref. 2.

Equilibrium data for systems of more than two adsorbable components are difficult to find. Very often such data will have to be obtained experimentally. It is reported[12] for the carbon system mentioned above, binary equilibrium data were used to predict ternary system data by employing the relationship

$$\frac{n_1}{n'_1} + \frac{n_2}{n'_2} + \cdots + \frac{n_n}{n'_n} = 1$$

where $n_1, n_2, \ldots n_n$ are the quantities of each component actually adsorbed from the mixture, and $n'_1, n'_2 \ldots n'_n$ are the amounts of the pure components adsorbed at the same total pressure and temperature. Additional relationships employed were:

$$\alpha_{12} = \frac{y_1 x_2}{y_2 x_1}$$

$$\alpha_{23} = \frac{y_2 x_3}{y_3 x_2}$$

$$\alpha_{13} = \frac{y_1 x_2 y_2 x_3}{y_2 x_1 y_3 x_2} = \frac{y_1 x_3}{y_3 x_1}$$

$$x_1 = \frac{n_1}{n_1 + n_2 + n_3}$$

α is called the relative volatility and is analogous to the α used in distillation theory. Note that subscript 1 in this case refers to the less strongly adsorbed component.

Kinetics Examination Is Important

One should never forget that the discussion so far deals with equilibrium data. Prior to reaching this equilibrium state there is the possibility of an inversion in selectivity due to a more rapid rate of diffusion of the less strongly adsorbed component. A typical case was studied by H. W. Habgood.[10] He found that, although molecular sieve Type 4A selectively adsorbs methane from mixtures of nitrogen and

methane, prior to the time when equilibrium is reached the adsorbent shows a temporary selectivity for nitrogen due to a more rapid nitrogen diffusion rate.

This illustration is important for two reasons:

- It points out the necessity for examining the kinetics of adsorptive separations.
- It shows that knowledge of kinetics may very well permit separations which might appear unfeasible if only equilibrium data are examined.

Adsorption Kinetics

Just as the various theories of adsorption lead to different expressions for the equilibrium state, so also do they lead to different rate expressions. Again, unfortunately, no one approach is completely satisfactory. In general, physical adsorption is an extremely rapid process. So rapid in fact, that it is often virtually impossible to measure the rate.

Relatively few rate data are to be found in the literature compared to the amount of equilibrium data published.

In attempting to apply conventional techniques such as the Htu. concept to the design analysis of the conventional dual fixed-bed adsorption system, there is the problem that a large amount of experimental data are required even for relatively simple systems. This is especially true for those cases in which the Htu. varies in height across the mass transfer zone.

Whenever sufficient information is available this approach may be used. Application of the method is described in the literature.[17]

Unfortunately, many literature discussions of adsorption kinetics stop at this point and leave the impression that a satisfactory design can now be made. The case is not so simple.

Let us begin by looking inside a simple adsorption system which is removing a single adsorbable component from a nonadsorbable carrier stream. Fig. 12 is a picture of the concentration profile in the bed after a steady state wave has formed and begins to move through the column.[17]

New MTZ Approach

At the inlet end of the bed, the adsorbent is saturated to essentially equilibrium value with the adsorbable component in the fluid. At the effluent end of the bed, fluid is in equilibrium with activated adsorbent. Between the two zones is a zone in which fluid concentration of adsorbable component is falling. It is called the mass transfer zone or MTZ. Length of this zone is a measure of how quickly adsorption is occurring. If the rate of adsorption were infinitely rapid a square wave would be produced as shown in Fig. 13. Real MTZ's are not square waves because there are resistances to diffusion and adsorption which must be overcome.

The MTZ length is independent of the bed length. It is a function of:

1. Adsorbent.
2. Adsorbent particle size.
3. Fluid velocity.
4. Fluid properties.
5. Adsorbate concentration in entering fluid.
6. Adsorbate concentration in the adsorbent if the latter has not been fully reactivated.
7. Temperature.
8. Pressure.
9. Past history of the system.

MTZ lengths can be obtained experimentally, suitable graphical correlations plotted, and the plots can then be used for design purposes. Data are determined in insulated test columns, fitted with thermocouples, pressure regulating and measuring devices and sampling taps.

This approach is relatively new and there is not a great deal of MTZ length data to work with. It is not yet apparent that the parameters listed above can be grouped into convenient combinations for correlation purposes. In some cases examined, MTZ lengths have been plotted as a function of superficial fluid velocity, in others as a function of fluid mass velocity. Generally, straight line relationships on linear paper have resulted. It would not be surprising to find MTZ length a function of N_{Re}, for example, since many mass-transfer correlations contain this grouping.

Certainly, refinements can be expected as more data are gathered in a variety of systems. It is sufficient for present design purposes to know that MTZ length can be related to the nine parameters listed above.

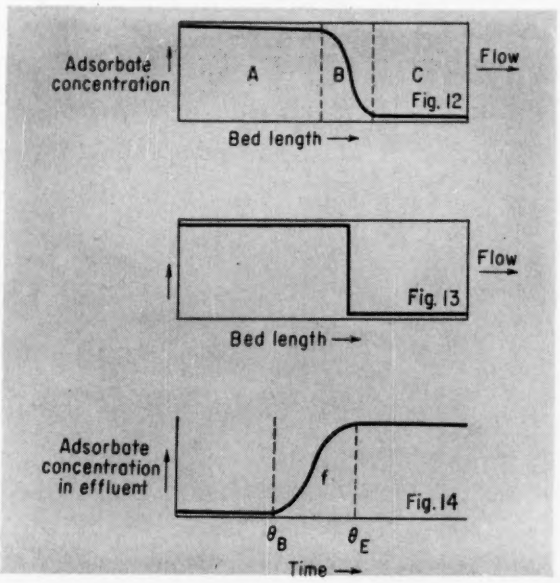
Ordinarily, parameters 1, 2, 4, 6, 7, and 8 can be fixed and held constant in both prototype and full-scale units so that velocity and concentration effects on MTZ length are available with a few experimental runs.

In the prototype system the column is usually operated until exhausted so that a continuous effluent concentration profile is obtained as in Fig. 14. Such a plot permits calculation of the length of the MTZ as described in Ref. 17. The equation for MTZ length Z_A is:

$$Z_A = Z\left[\frac{\theta_A}{\theta_E - (1 - f_M)\,\theta_A}\right]$$

where

Wave Profiles Show Adsorption Mass Transfer



Z = packed depth of the test column.
$\theta_A = \theta_E - \theta_B$
θ_E = time to bed exhaustion.
θ_B = time to break-through.
f_M = fraction of MTZ not loaded with adsorbate.

In Fig. 14, f_M is the ratio of the area f to the total area between θ_B and θ_E. Actually, f_M is often approximately 0.5 but may vary from about 0.35 to 0.65 depending on the shape of the breakthrough curve.

Some Upsetting Variables

The analysis cannot stop here. In adsorption systems there are several additional variables which can upset any precise mathematical model and equations which may be used. Briefly, these are:

1. Granting that accurate test data have been obtained on samples of the adsorbent, adsorbent capacity may vary somewhat from batch to batch. Ordinarily this variation is small and can be neglected.

2. Adsorbent particle size distribution may vary somewhat and cause minor differences in transfer zone lengths. Transfer zone length increases with increasing average particle diameter.

3. Bed packed density will usually tend to increase as the bed is cycled. For molecular sieve Type 5A ⅛ in. pellets, for example, density varies from 43.4 lb./cu. ft. for a newly packed bed to 47.5 lb./cu. ft. for a settled bed. The author does not have data on other adsorbents but is aware of a similar variation in commercial units containing a variety of adsorbents. Again, a shortening of the transfer zone may be expected. In addition, increase in pressure drop will occur as the bed packs more densely.

4. In many systems heat effects can and should be ignored to simplify design procedures. Some variation, however slight, between design and actual performance must be expected.

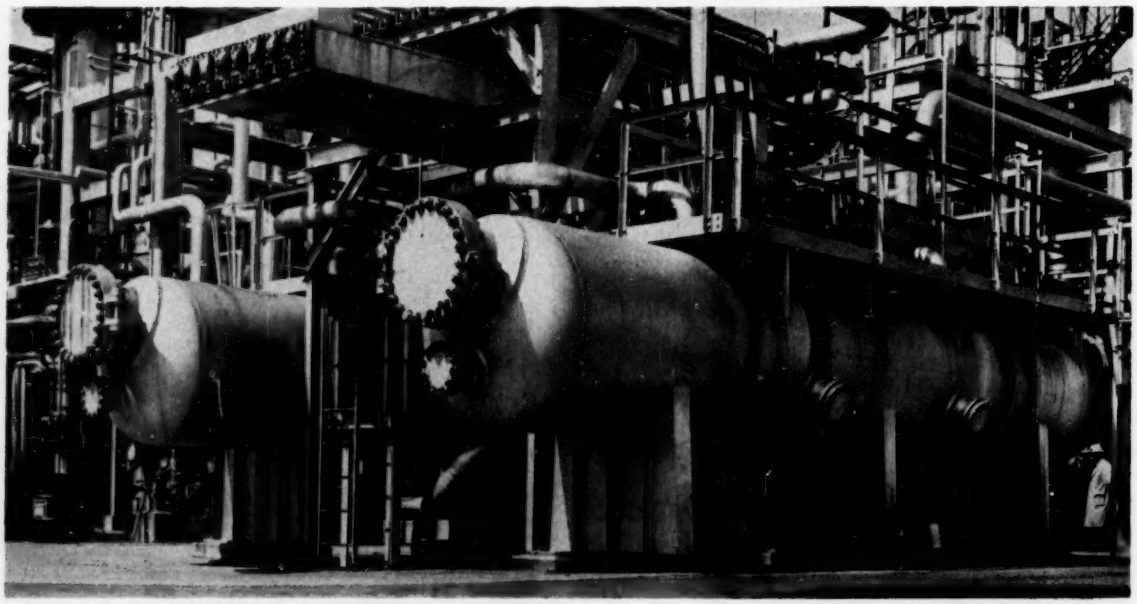
5. No matter how well designed the equipment may be, variations do occur in stream temperatures, especially during regeneration. Affect on adsorption is usually negligible.

6. Variations occur in the rate of fall-off of absorbent capacity. This is sometimes the most troublesome area to deal with since it can be so unpredictable. Even carrying out extensive life study tests can prove frustrating. In going from prototype system to plant installation, it occasionally happens that the plant stream will contain some contaminating trace of impurity which was not present during test work.

This list has been included here not to discourage but to help justify a continuing search for design techniques which are reasonably simple and straightforward, rather than some of the truly complex and time-consuming theoretical methods (frequently seriously hampered by assumptions valid in rare cases only) which have been proposed in the literature on adsorption.

Development of the mass-transfer-zone concept is certainly one of the routes to such a design procedure. It has been found possible to develop the concept to a point where complex multi-component systems can be designed with a minimum of experimental data. These designs take into account such things as change in adsorbent performance with time in service and the heat effects which occur simultaneously with mass transfer. Such design procedures have not yet appeared in the literature.

In a typical design, you would fix bed diameter based on capacity requirements; then calculate MTZ based on stream velocity, and the equilibrium zone behind MTZ from equilibrium data. Adding these two zones



HORIZONTAL DUAL ABSORBER drys gas in refinery; absorbent is steam reactivated (Pittsburgh Lectrodryer).

with a factor for fall-off in capacity due to recycling gives adsorption column size. Of course, length of cycle, regeneration requirements and pressure drop all have to be considered in arriving at an optimum design.

Adsorbent Stability in Cycling Service

Several times in the section above we have mentioned that adsorbent performance changes with time in service. The phenomenon is so fundamental to an understanding of adsorption and adsorption economics we would now like to discuss it in some detail.

One factor which invariably complicates obtaining data and applying them to design procedures is the fact that all adsorbents tend to lose capacity with time.

Capacity loss with time in service can be due to either a change in the adsorbent itself, a loss due to accumulation on adsorbent surface of some unregenerable contaminant, or a combination of the two factors.

The first kind of loss occurs, typically, on hydrophilic adsorbents (alumina, silica gels, and molecular sieves). A decided loss, perhaps as much as 10 to 20% of initial equilibrium capacity will occur during the first few cycles. The fall-off curve will then plateau and fall off only at a very slow rate. A plot of log capacity versus log of the number of cycles will often produce a straight-line relationship.

The second type of capacity loss is frequently encountered when adsorbents are used in hydrocarbon service. Two types of contamination are likely to occur. The first is due to polymerization of unsaturated hydrocarbons. Materials in the C_4 range are particularly bad actors. Polymers formed are of such high molecular weight that ordinary regeneration procedures fail to remove them.

Even in the absence of unsaturated materials, trace amounts of heavy hydrocarbons may tend to accumulate in an adsorption system. Again, ordinary regeneration procedures may fail to remove them.

Watch for Unexpected Reactions

There are many unexpected reactions which can occur in adsorption systems. Whenever possible, it is wise to supply the adsorbent manufacturer with a complete stream analysis and ask him to evaluate it for fouling problems. For example, several of the commonly used adsorbents will catalytically convert H_2S to free sulfur in the presence of trace amounts of O_2.

Capacity loss problems obviously affect design economics. What to do? Well, if water vapor is the only problem, the adsorbent manufacturer should be able to supply data on extent of capacity loss for the operating conditions selected. Likewise, the manufacturer can often supply data on other types of capacity loss, and it is wise to check with him before undertaking test work. Even in the absence of actual data, he can often supply an educated guess which will often suffice and save the time and expense of running cyclic tests.

If there is a serious doubt as to cyclic performance, some test work should be carried out. A small system can be set up and cycled automatically on a short cycle. Every 10 or 100 cycles, the equilibrium capacity and transfer zone length can be checked. When data are consistent and can be fitted to a smooth curve it is usually safe to extrapolate.

It should be pointed out that capacity loss may be due to length of time the adsorbent is exposed to some material at some high temperature, or it may simply be due to the number of times it is cycled, or a combination of the two. When time and money permit, attention should be paid to the cause.

Equipment and Process Design Factors

When to use two-bed or three-bed systems; how to avoid excessive costs; and important points on regeneration—pros and cons about process cycles.

The simplest fixed-bed used for adsorption is a cylindrical vessel filled with solid adsorbent. Gas or liquid containing adsorbate flows in the direction of the cylinder axis. Most adsorption vessels of this type operate adiabatically. They can be regenerated by passing a hot gas through the bed.

Ordinarily, it is desirable to have the regeneration or purge gas flow in an opposite direction to the gas during adsorption. This helps to keep the effluent end of the bed free of adsorbate: important in many cases since it is the effluent end of the bed which controls the impurity level of the purified gas or liquid.

Adsorption vessels are usually used in pairs with one bed being desorbed while the other is adsorbing. The vessels usually stand on end. Flow may be either upward or downward during adsorption.

With gaseous systems, direction of flow is normally of little importance. There is some difference of opinion about whether flow should be up or down in liquid systems. Choice can frequently be left to the equipment manufacturer. In either gaseous or liquid systems, downward flow permits use of higher velocities which are sometimes desirable. In upward flow, velocity must be maintained below that which will lift or boil the bed. Any violent agitation in the bed will cause adsorbent attrition.

Another type of bed commonly used when large volumes of gas must be handled is a cylindrical vessel

(horizontal axis). This contains a shallow horizontal bed which runs the length of the cylinder. Gas to be purified enters through a header and flows in a direction perpendicular to the cylinder axis through the shallow bed at a reasonably low velocity.

Returning to the cylindrical beds first mentioned, you will find them used in three-bed as well as two-bed systems. Three-bed systems are used for one of the two following reasons:

- Regeneration and bed cooling usually set the lower limit on the cycle time which may be used. It is sometimes possible to reduce over-all investment cost of a system by using three beds with one bed adsorbing, one bed desorbing, while the third bed is cooling. The adsorption cycle is then appreciably shorter; consequently bed size is smaller and lighter steel may be used in fabrication.
- Three beds are sometimes installed so two may be used in series while the third is regenerated. Such a system permits each bed to be run until it is loaded to equilibrium capacity. It is frequently difficult to justify such a design on an economic basis. It is used with adsorbents which approach equilibrium slowly.

To avoid construction problems by keeping adsorption vessels below heights of 30 ft. or so, many vessels may be installed in a single system and operated as multiples of either the basic two- or three-bed systems. Such large installations are found in the natural-gas industry at low-temperature stripping plants where water must be removed to prevent freeze-up of low-temperature distillation columns.

A new technique being developed at some of these plants is to use an inexpensive adsorbent for removing the bulk of water in the gas. At the effluent end of the bed a trimmer layer of high-capacity adsorbent is installed to remove the last traces of water. Ref. 4 contains a detailed economic study of such a compound-bed installation used for treating refinery off-gases.

Different adsorbents are also used in other systems where a variety of impurities must be removed. A case is reported[19] where activated carbon followed by molecular sieves is used to remove traces of methane, carbon monoxide and nitrogen from hydrogen at −300 F.

Regeneration Presents Problems

When molecules adsorb on a solid surface, energy, in the form of heat, is released. Adsorption is an exothermic process. To remove molecules which are adsorbed on a surface, energy, again in the form of heat, must be given to them. Heat of desorption is equal to the heat of adsorption and may be calculated, as explained previously, from the isostere. In general, values of the integral heat of adsorption for the typical case will range from about a low of 300 Btu./lb. to a high of about 1,500 Btu./lb. of adsorbate adsorbed. These values apply to physical adsorption systems. Heats of adsorption are approximately of the same order of magnitude as the latent heats of condensation of the adsorbates.

Cycling Adsorption Procedures

In this section we shall discuss some cycling procedures for the adsorption-desorption cycle.

In the thermal swing cycle, heat is put into the system to effect desorption. In some of the other cycles, this is not so obvious. For example, though we may speak of an isothermal pressure-swing cycle, the process is by no means isothermal although the actual temperature change of the system may be small compared to the thermal swing cycle.

Likewise, when employing a purge-gas-stripping cycle, if the purge gas and saturated adsorbent bed are initially at the same temperature, we will find that temperature will gradually drop as adsorbate is removed from the bed.

When regenerating a bed by means of the conventional thermal-swing cycle it is usually found that desorbate does not leave the bed at some fixed concentration level until it is all removed. Rather, the desorbate will tend to come out almost all at once while continued purging with a hot gas will remove the last traces only slowly.

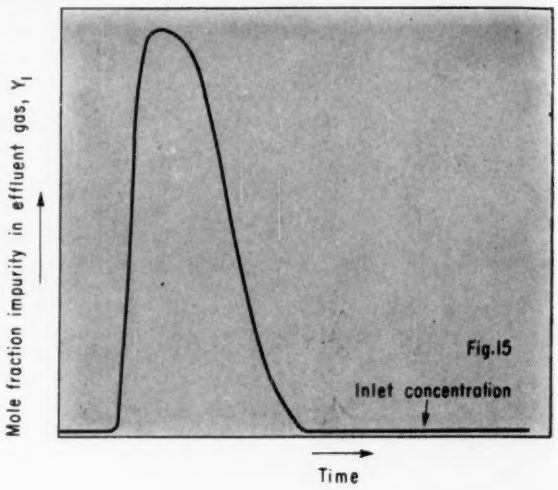
If the mole fraction of desorbate in the effluent gas is plotted as a function of time, a curve such as Fig. 15 will usually result.

Such a curve is generally of little interest. However, if it is desirable to conserve or prevent the waste of purge gas, we can estimate from Fig. 15 when to begin recirculation of the gas.

Again, we might be interested in recovering the desorbate. Since the desorbate is very concentrated in only a portion of the purge gas, it will probably prove cheaper to treat only this portion rather than attempt to treat the total effluent which would be more dilute.

In the section which follows there are descriptions of the various operating schemes which can be applied to fixed-bed systems.

Impurity Changes in Hot Gas Regeneration



What About Process Cycles?

A convenient classification of adsorption process cycles[5] is the following:

- Thermal-swing cycles.
- Pressure-swing cycles.
- Purge-gas-stripping cycles.
- Displacement cycles.

• Cycles which employ a variety of combinations of the above four.

Thermal-Swing Cycles—Thermal swing is defined as any cycle which employs different temperature levels for adsorption and desorption. Desorption temperature is always higher than for adsorption. A major feature of using a thermal-swing cycle is that high adsorbent operating loadings can usually be obtained on the adsorbent. However, a cooling step must usually be considered as an additional item of expense.

Two methods for transferring the heat required to raise and lower the adsorbent temperature are by (1) direct and (2) indirect heating. An example of direct heating: passing hot gas through the adsorbent bed. In this case, simultaneous purge gas stripping occurs. In indirect heating, the heat-transfer fluid does not come in contact with the solid adsorbent. Use of heating coils within a bed is an example of the indirect method. From a process standpoint, the methods differ primarily in the quantity and type of purge gas used, which in turn, affect the type and size of auxiliary process equipment required.

Pressure-Swing Cycles—Adsorptive separation processes can be operated at close to constant temperature by conducting adsorption under pressure and desorption under a reduced total pressure. An operating temperature level should be chosen so desorption will readily occur upon a moderate pressure reduction. For higher adsorbent operating loadings, vacuum desorption may be necessary to reduce residual adsorbate.

This type of a cycle is simple because no heating and cooling steps are involved. Any heat requirements to maintain bed temperature may be provided by the adsorber feed stream itself. Because additional time is not required for heating and cooling the beds, the pressure-swing cycle, as well as other adiabatic cycles, can generally be designed to operate more rapidly than thermal-swing cycles. A fast cycle materially reduces the adsorber dimensions and the adsorbent inventory. An additional advantage is the pressure-swing cycle's ability to use gas compression as the main source of energy for the separation process.

Purge-Gas-Stripping Cycles—Purging an adsorbent bed with a nonadsorbable gas will reduce partial pressure of the adsorbed component in the vapor space and cause desorption. In this sense, the mechanism is similar to desorption by reduction in total pressure. Purge gas may be either a condensable or a noncondensable fluid at normal operating conditions. In either case, the term "purge gas" as used here refers to a nonadsorbed or only slightly adsorbed fluid to distinguish it from the adsorbed fluids used in displacement desorption cycles. If the recovered purge gas is to be recycled it must first be purified of adsorbate to avoid re-adsorption.

Purge-gas stripping is generally more efficient at

Comparing Manufacturing Expense of Adsorption and Distillation—Table II

(4,000 BPSD Hydroisomerization)

	Unit	$/Unit	Molecular Sieve Consumption Calendar Day[a]	Molecular Sieve $/Calendar Day[a]	Fractionation Consumption Calendar Day[a]	Fractionation $/Calendar Day[a]
Utilities						
Steam	M lb.	0.40	124	50	2,100	840
Fuel	MM Btu.	0.20	752	150	288	58
Electric power	kwh.	0.008	14,000	112	8,280	66
Cooling water	M gal.	0.01	4,200	42	9,849	98
Operating Labor						
2 operators/shift	Man hr.	2.80	48	134	48	134
1 supervisor/shift	Man hr.	3.75	24	90	24	90
Isomerization catalyst replacement[b]	lb.	3.70	30	110	31	115
Molecular sieves[c]	lb.	1.00	326	326	.....	.....
Hydrogen makeup	MM Btu.	0.20	106	21	89	18
Amortization[d]				645		791
Maintenance[e]				286		312
Insurance and taxes at 3%/yr, on plant investment				191		234
Interest at 3¼%/yr. on total investment				234		260
Overhead at 3%/yr. on plant investment				191		234
Royalty[f] (isomerization)				90		90
Total manufacturing expense				2,672		3,340

a. 90% on-stream efficiency.
b. 100 bbl. of reactor feed/lb. catalyst.
c. Two-yr. life.
d. Based on an average rate of 10.15%/yr. for the first 5 yr. of a 15-yr. declining balance amortization calculation.
e. 4½%/yr. and 4%/yr. on plant investment for molecular sieves and fractionation, respectively.
f. 5.7¢/bbl. of converted product.

higher operating temperatures and lower operating pressures. Because gas stripping works best at low pressures, the desorption step should be carried out at as low a pressure as economically possible. To increase adsorbent operating loading, the adsorption step may be carried out at higher pressures or at lower temperatures than that of desorption.

Use of a condensable gas is advantageous for the following reasons:

- Power requirements for fluid circulation are reduced substantially when a liquid pump instead of a gas blower or compressor is used to circulate the fluid through the furnace, heat exchangers and adsorbers.
- Effluent stream may be condensed and the desorbed material separated from the purge fluid by simple distillation or other means. Contamination of the circulating fluid by the desorbate can be readily controlled.

Displacement Cycles—Adsorbents may be desorbed by introducing another adsorbable fluid which displaces all or part of the previously adsorbed material. The displacement fluid may be more strongly adsorbed, or less strongly adsorbed than the adsorbate being displaced. In either case, desorption is dependent on the relative adsorptivities of the displacing fluid and the adsorbate. When a more strongly adsorbed fluid is used as the displacing agent, it will be adsorbed and displace the less strongly adsorbed material that was on the adsorbent. Little or no partial-pressure stripping action occurs. When a less strongly adsorbed fluid is used as the displacing agent, desorption is due to both displacement and partial-pressure stripping.

In general, displacement purging is useful when the material to be desorbed is heat sensitive.

Use of a less strongly adsorbed gas as a displacement fluid entails a higher displacement-gas circulation than required with a more strongly adsorbed gas. But there is a major advantage with the former: removal of the displacement agent can usually be accomplished by displacement with the adsorbate from the feed during the adsorption phase of the cycle.

Return on Investment and Payout on Hydroisomerization: Adsorption vs Distillation—Table III

	Molecular Sieve Separation	Fractionation
Feed		
Charge rate, bbl./stream day (BPSD)	4,000	4,000
Octane number, F-1 +3 cc. TEL	88.5	88.5
Unit value, $/bbl	4.74	4.74
Daily cost, $/stream day (SD)	18,940	18,940
Isomer Product		
Quantity, BPSD	3,959	3,953
Octane number, F-1 +3 cc. TEL	99.5	97.6
Unit value, $/bbl	6.17	5.73
Daily realization, $/SD	24,400	22,670
Profit Margin		
Product realization, $/calendar day (CD)	21,960	20,403
Feed cost, $/CD	17,050	17,050
Difference, $/CD	4,910	3,353
Fuel gas credit, $/CD	52	52
Total, $/CD	4,962	3,405
Operating cost, $/CD	2,672	3,340
Profit margin, $/CD	2,290	65
Tax, 52%, $/CD	1,190	33
Profit margin after taxes, $/CD	1,100	32
Depreciation, $/CD	645	791
Cash income after taxes, $/CD	1,745	823
Payout		
Plant investment, $	2,320,000	2,845,000
Payout time, yr	3.6	9.5
Return on investment		
Initial investment, $	2,632,800	2,920,000
Ratio of initial investment to annual cash income	4.13	13.1
Return on investment, %/yr	24.2	7.6

Important Adsorption Economics

Adsorption now competes with distillation for gasoline-upgrading jobs. Equipment is generally simple—steel tanks and inexpensive auxiliaries.

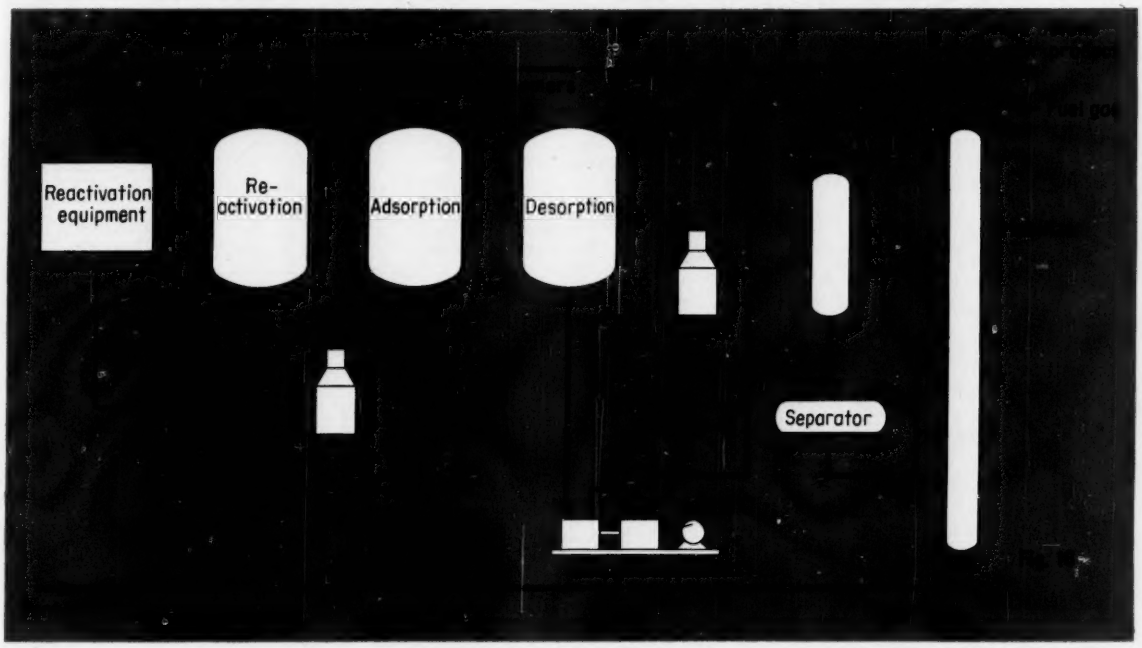
During this past year alone three different processes employing adsorption for improving gasoline stocks were announced.[8, 9, 9] Cost data[9] are contained in Tables II and III and illustrate the economics and improved separations which are possible with adsorption. A flowsheet for this process is shown in Fig. 16. It should be pointed out that too precise a fractionation was avoided and a looser separation chosen compared with molecular sieves, to avoid penalizing fractionation.

Adsorption investment and operating costs are very sensitive to the type of regeneration scheme selected. As with distillation, small changes in desired product purity levels can have a substantial effect on investment costs. Standard economic evaluation techniques can be applied to the study of adsorption systems.[11]

What Equipment to Use?

Equipmentwise, adsorption presents no new problems to the design engineer. Adsorption vessels them-

Molecular Sieves Upgrade Gasoline: Vacuum Process with Hydroisomerization



selves are nothing more than steel tanks. All auxiliary equipment is familiar—pumps, compressors, blowers, heaters, heat exchangers, piping, valving, insulation.

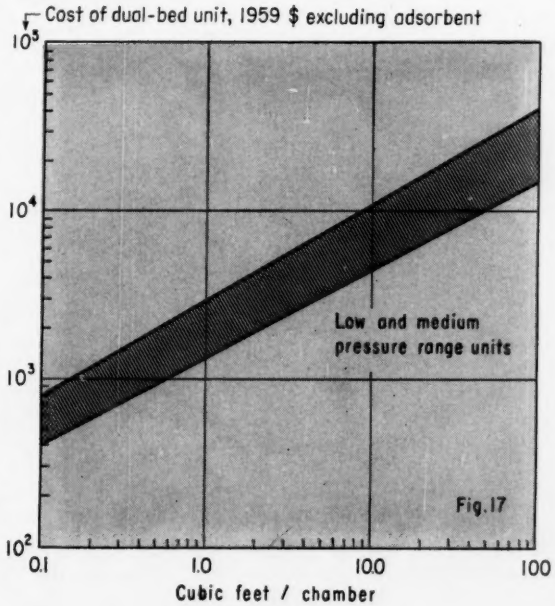
Occasional problems are encountered in selecting and applying commercially available equipment. For example, in design of a rapid-cycle vacuum-regeneration scheme for a hydrocarbon separation system Linde engineers experienced some difficulty in selecting a satisfactory vacuum compressor and driver combination. The problem resulted from an unusual property of the adsorbent bed. During regeneration by evacuation, pressure in the system varies not only because the compressor reduces the gas content in the free space in the vessel but also varies with the adsorption isotherm. It is analogous to having a leak in the system, the rate of leakage, however, being a function of the isotherm or concentration of adsorbate still remaining in the adsorbent. Coupled with the pressure drop across a large bed, it took hours of trial and error calculations to fix the choice of compressor properly loaded so as to reduce horsepower requirements.

Unusual cases like this should not deter anyone from exploring adsorption as a potential separation technique for a given problem. The typical system can often be purchased as a package from one of the many equipment vendors in the field.

As a general rule, adsorption equipment prices are reasonable, first, because the field is highly competitive, and secondly because a small line of equipment will serve for a wide variety of applications. This means low engineering cost to the purchaser. Most equipment vendors will quote on unusual designs or features when requested. Although there are exceptional cases, it usually pays to purchase equipment rather than attempt to construct it in one's own shop. Fig. 17 contains data on approximate cost of standard package units.

Perhaps the best general remark which can be made to help guide the selection is this: Keep the adsorption

Cost Ranges Vary for Equipment



Adsorptive Separations Likely To Be Commercialized In The Next Few Years—Table IV

Gases and Liquids	Separations and Purifications
It appears that there is almost no gas or liquid which cannot be dried by one or more of the adsorbents presently available.	H_2S and CO_2 removal from a variety of streams containing large percentages of these impurities. Removal of straight chain hydrocarbons from many kinds of hydrocarbon mixtures. Recovery of ethylene and propylene from various process streams.

system as small as possible; cycle the unit as rapidly as possible.

Where Is Adsorption Headed?

New adsorbent manufacturers have appeared on the scene, investing millions of dollars in the development and promotion of new adsorbents to supplement the many adsorbents already available. In the last three or four years there has been a surge in the number of adsorption equipment manufacturers. They are apparently doing well in this already competitive field. New processes are being developed which require separations that are almost if not impossible to perform with the conventional unit operations. Process developments and improvements are being made which depend on stream purities much too expensive to attain unless by adsorption.

By no means, however, is adsorption a cure-all. There have been numerous cases where adsorption—at least until now—has proved less economical. An example of this is light-oil scrubbing of natural gasoline from natural-gas streams. Adsorption works, certainly, but it may not replace absorption except perhaps in the smaller stripping plants where silica-gel adsorbers have proved successful.[6, 18] One of the factors which contributes to the success of this small-scale operation: silica gel adsorbers are installed primarily for drying the gas. By properly sizing the units they can also be made to recover the gasoline fraction.

Again, although Hypersorption systems have been operating successfully for a number of years, and new molecular sieve hydrocarbon separation systems are being designed, no one believes for a moment that either or both can replace distillation completely. It is a little early to attempt to evaluate the place molecular sieve adsorbents will have in the hydrocarbon separation field. It is almost certain, however, that their ability to adsorb selectively on the basis of size will guarantee them a place of importance.

Table IV contains a brief list of some of the separations which are likely to be commercialized in the next few years. It is somewhat difficult to make such a list complete because of the very nature of the problem.

Whether the list is complete or not, there is no doubt that adsorption is fast becoming a unit operation of major importance.

HENRY M. BARRY when preparing this Report was a technical service representative and marketing analyst at Linde Co., Div. of Union Carbide, associated primarily with molecular sieves. He is now on the staff of Linde's electric welding division. He has a B.A. degree from Fordham Univ. After 2 yr. military service, Mr. Barry joined Consolidated Edison as a member of the mechanical engineering department. This was followed by 2 yr. in the technical service department of Socony Mobil, before joining Linde. Mr. Barry, presently completing requirements for a master's degree in chemical engineering (he received a B.Ch.E. from N.Y.U. in 1957) is a member of Tau Beta Pi, A.C.S. and A.I.Ch.E.

REFERENCES

1. de Boer, J. H., "The Dynamical Character of Adsorption," Oxford Univ. Press, Oxford, 1953.
2. Brunauer, S., "The Adsorption of Gases and Vapors," Princeton Univ. Press, Princeton, 1945.
3. Carson, D. B. and D. B. Broughton, *Pet. Ref.*, Apr. 1959, p. 130.
4. Cochrane, G. S., *Chem. Eng.*, Aug. 24, 1959, p. 129.
5. Cremer and Davies, "Chemical Engineering Practice" Vol. 6, Chap. 7, Academic Press, New York, 1958.
6. Dow, W. M., *Pet. Ref.*, Apr. 1957.
7. Ergun, S., *Chem. Eng. Progr.*, **48**, 89 (1952).
8. Franz, W. F., et al., *Pet. Ref.*, Apr. 1959, p. 125.
9. Griesmer, G. J. et al., "Hydrocarbon Separation Process Utilizing Molecular Sieves", paper presented at Annual Meeting of the American Chemical Society, Oct. 1959.
10. Habgood, H. W., *Can. J. Chem.*, **36**, 1384 (1958).
11. Hiester, N. K. and R. C. Phillips, *Chem. Eng.*, Oct. 1954, p. 161.
12. Kapfer, W. H. et al., *A. I. Ch. E. Jour.*, **2**, 456 (1956).
13. Kasten, P. R., and N. R. Amundson, *Ind. Eng. Chem.*, **44**, 1704 (1952).
14. Labine, R. A., *Chem. Eng.*, Aug. 10, 1959, p. 104.
15. Mantell, C. L., "Adsorption," McGraw-Hill, New York, 1951.
16. Plitt, F. H., *Pet. Ref.*, July 1959.
17. Treybal, R. E., "Mass Transfer Operations," McGraw-Hill, New York, 1955.
18. Small Volume Pure Hydrogen at Bulk Cost, *Chem. Eng.*, Aug. 10, 1959, p. 60.
19. Linde bulletin F-8614 describes McBain spring balance technique.

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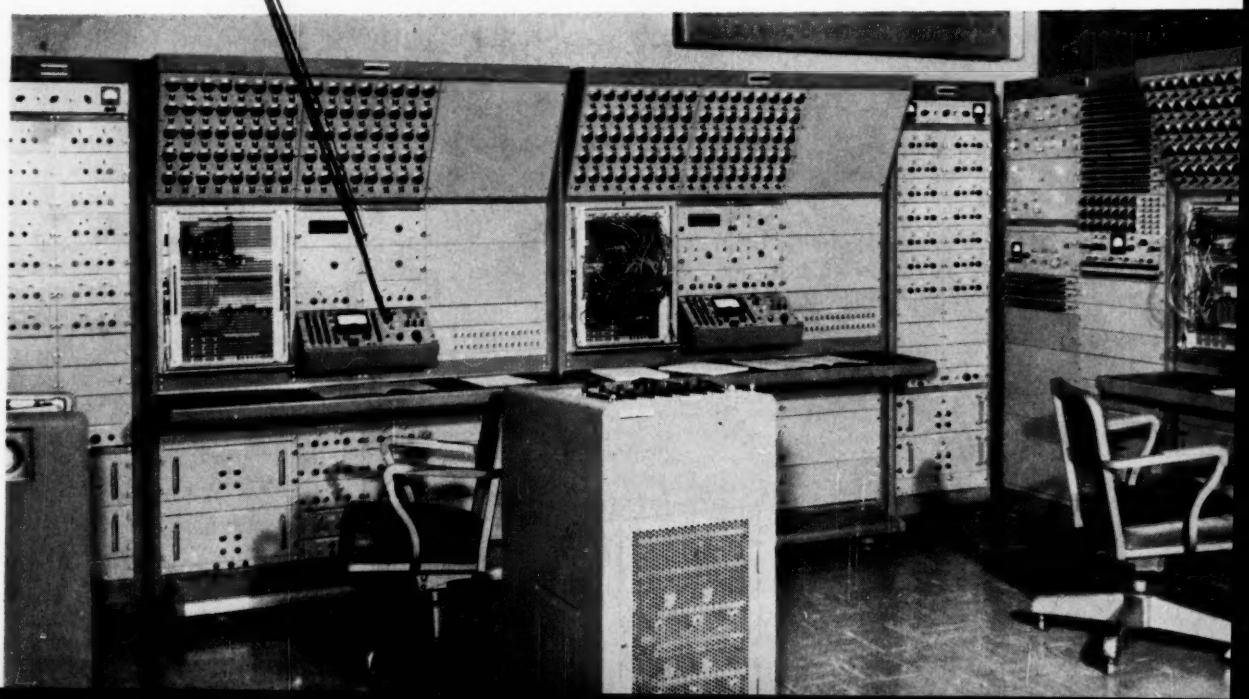
. . . find out what the CPI engineer should know about

Systems Engineering

THEODORE J. WILLIAMS, Monsanto Chemical Co., St. Louis, Mo.

SYSTEMS engineering promises fat dividends in the chemical process industries. But systems engineering, as well as techniques for its application, is only little understood by the chemical engineer. One reason may be that there has never been published a comprehensive treatment of the subject in the chemical engineer's terms.

The author is grateful to the University of Texas chemical engineering department for inviting him to present his concepts of systems engineering with an over-all process example at the 4th annual Schoch Lecture, Oct. 16-17, 1959. This example—which we will develop in an exclusive CE series this year—shows advantages of systems engineering over conventional methods. It details differences in procedures, necessary new information, required tools and the actual increases in return on investment from the systems-designed plant.



Systems Engineer Aids 3 Areas—Table I

▶ Kinetics and Process Development
Aids the research chemist in developing nature and characteristics of process chemical reactions. Reduces, by fullest possible use of computers in process development, experiments necessary to prove process and establish desirable operating conditions.

▶ Plant Design
Optimizes process in design stage to obtain best combination of process conditions and plant design and assure maximum return on investment.
Obtains best unit design by computer use—especially where trial-and-error procedures are required. Correlates process dynamics and control studies directly with process unit design studies.

▶ Plant Operations Optimization
Studies existing plant operations to determine what, if any, changes in operation or control systems would improve return on investment.
Studies each new technique of plant control to determine applicability to existing processes.

It is impossible to draw such a complete example from a real system because of the proprietary nature of the resulting information. The example, therefore, is a fictionalized one, but it will still be entirely realistic in engineering details presented.

In this series, beginning here, we will explore with you the present status of systems engineering: what we already know, how we apply what we know, what we need to find out and what our visions of the future show us.

Engineers have begun to realize that they can no longer think of a process plant as a collection of individually designed operations and processes.

It's increasingly apparent that each separate unit of a plant influences all others in both obvious and subtle ways. Though some of the subtle influences are readily found, others can be pinned down only after long study and experimentation.

Recognition of plant interactions is found, for example, in the evolving design philosophy that control instrumentation should be specified for a whole process system—not for each unit separately.

During the growth of recognition, the CPI has met tighter competition—domestically because of overexpansion, abroad because of birth and rebirth of vigorous chemical industries. The competition has spotlighted three needs of the American chemical industry: shorter lead-time from lab to commercial plant, better designed and built plants for higher profitability, and optimum production in all operating plants.

The technical advances paired with the pressure of competition have sired a new concept of chemical plant engineering and operation. This concept combines advanced chemical engineering science with the tool of electronic computers and the viewpoint of considering the process as an entity. The combination has come to be known as systems engineering.

Systems engineering has been promoted in the CPI over the past few years by variously motivated groups. Defined by these groups, systems engineering ranges all the way from advertising gambits for particular lines of equipment to application of operations research and cybernetics to processing.

At Monsanto, we have evolved our own definition. We feel that our definition is best for the chemical industry and that it will result in greatest gain for our company. The definition is operative in terms of four requirements for application of systems engineering.

- The chemical engineer must deliberately attempt to consider plant design an integral problem—to balance chemical kinetics, heat and mass transfer, process dynamics and instrumentation and control.
- He must recognize that use of electronic computers and advanced mathematical techniques will usually be required to properly evaluate and describe the numerous, complex relationships of such a comprehensive approach.
- Management must recognize that more time and data than have been considered necessary in the past will be required in the development of chemical processes.
- Application of systems engineering will result in use of all automatic control concepts which can be economically justified.

In conventional practice, chemical engineers seek to optimize steady-state operation of processes. Through systems engineering we have the tools to quantitatively optimize unsteady-state operation—to minimize magnitude and duration of process upsets and shorten and simplify plant startup.

Systems Approach to Problems

Many plants are designed with only partial knowledge of the chemical reactions involved and using approximation formulas for heat and mass transfer coefficients. Use of large safety factors is necessary to assure that a particular plant unit adequately performs. But this results in excess investment costs.

The fat can be trimmed only by obtaining more exact expressions for heat and mass transfer relationships to properly size equipment. Even more important, we must find out as much as possible about the chemical reactions involved, particularly the effects of varying operating conditions on reaction rates and products.

The thesis of systems engineering is that it should be possible to operate chemical processing equipment at higher over-all average throughput to produce higher yields of better quality product at lower capital investment. But to design for this better performance, more and harder problems must be met.

Fortunately, the techniques and devices necessary for accomplishment are already available in what is really a new applied chemical engineering science but which also can be defined by our criteria for systems engineering. Their combination—described as systems engineering by some[2]—includes, in addition to process dynamics, process control and analog computer operation, large-scale digital computers and their use through applied mathematics, and finally the recent engineering research effort to re-explore fundamentals.

Perhaps the most striking change in chemical engineering knowledge has come in reaction kinetics. Where

How to Build an Analog Computer Facility in the CPI—Table II

Computer Components	Instructional Use Only	Instrumentation Response & Design	Control System Response; Some Process Dynamics	Complete Simulation of Chemical Process Systems	Monsanto's Analog Facility
Operational amplifiers	10–20	15–50	40–100	80–200+	228
Multiplication channels	1–2	2–5	10–30	50–100+	129
Function generation channels	1–2	2–6	5–10	25–50+	66
Operational relays	1–2	6	12	25–50+	48
Function switches	3	6	12	25–50+	45
Separate control consoles	1	1	1–2	2–3+	4
Plotting channels (x-y)	1	1	3	3–4+	4
Plotting channels (x-t)	2–4	6	12	18	18
Repetitive operation	Yes	If desired	If desired	If desired	Yes
Computer Personnel					
EE or ME (M. S. or equivalent)	1	1–2	2–3	3–6+	
ChE (M.S. or Ph.D.)	——	1	2–3	6–8+	
Computer repairmen	——	——	1–2	2–3+	
Shop arrangement	Open	Open	As desired	Closed	Closed

older methods required development of over-all orders of reaction and rate constants, the newer methods permit specification of each reaction step and its rate constant. Though the resulting systems of equations are very large, and determination of the resulting reaction constants can be quite difficult, computing machines now make such work practicable.

Too, methods are now being derived to determine physical properties of gaseous and liquid systems from a few readily made measurements of parameters of system components.[3] Such methods, when finally perfected, will be of immeasureable aid to plant design studies.

Finally, current experimental research is rapidly establishing dynamic behavior of process equipment under transient conditions, as when subject to upsets and during startup.

Combination of these advances is necessary and sufficient to give us the knowledge to implement systems engineering in the process industries. With this knowledge available today, the chemical engineer can consider all aspects of plant design as one unit whole.

Systems engineering techniques thus promise to establish a unity between research and engineering which seldom exists under conventional procedures. Instead of chemists embarking on a program of many lab and pilot plant experiments to seek optimum conditions, the chemist and engineer jointly plan a program of relatively few, but precisely measured, experiments to determine kinetic constants. Computer simulation of the reactions complements this, sometimes yields information useful to designers that is difficult or impossible to obtain by experiment.

Three benefits accrue:

• Because simulation is quicker and cheaper than experimentation, it is possible to reduce time required for research and engineering.

Staffing a Digital Computer—Table III

	Medium-Size Computer	Large-Size Computer
Statistics specialist • B.S.Ch.E. with M.S. in statistics, or • Ph.D. in Ch.E. with statistics minor	1–2	2–3
Chemical engineering design specialist • M.S. or Ph.D. in Ch.E.; applied math minor	2–3	4–8
Linear programming and operations research specialist • M.S. or Ph.D. in Ch.E.; applied math minor • M.S. or Ph.D. in math with B.S.Ch.E.	0–2	3–8

• Since processes are designed from fundamental kinetic data for optimum operating conditions, cost estimates are more accurate.

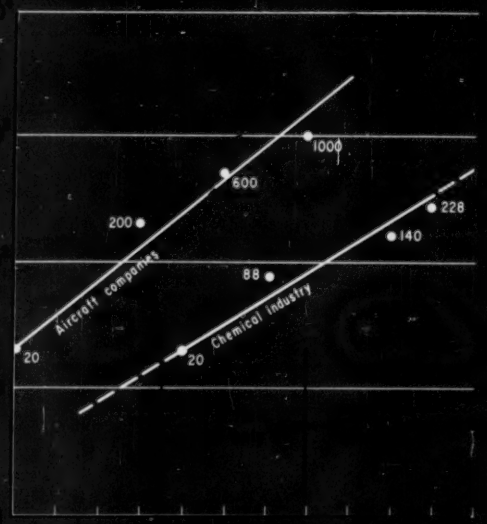
• Improved design eliminates excessive plant size, reduces investment by getting best possible performance and smooths out product quality.

Simulate With Analog Computers

We mentioned the vital relationship that use of computers bears to systems engineering; it can be said that systems engineering, as defined here, would be impossible without them. In addition, each type of

CPI Analogs Follow Earlier Aircraft Company Pattern

1944 First use of operational amplifier as computing aid (Bell Laboratories M9 anti-aircraft gun-laying computer).
1946 Engineers at Columbia University first use operational amplifier as generalized mathematical computing aid.
1948 First commercial analog computers (Reeves Instrument Co. and G. A. Philbrick Researches, Inc.).
1951 Removable patchboard developed by Reeves.
1952 Initial stages of advanced military aircraft development introduces 100-200 amplifier computers to aircraft industry.
1953 First application of small analogs to chemical process problems (heat transfer by Howe of Michigan; fluid flow by Chien, Hrones and Reswick of MIT; extraction by Acrivos and Amundson of Minnesota).
1955 First application of large-scale analog computer (88 amplifiers) to process problem (distillation column control) by Rose and Williams.
1956 Studies for ballistic missile systems demand 1,000-amplifier computers.
1[illegible] Large chemical companies build and expand analog computer facilities.



computer—analog and digital—has its own special field of application.[1]

There are four main uses for an analog computer:

1. Instruction in computer use, process dynamics and control system operation.

2. Investigation of instrumentation response and design.

3. Simulation of control system response and design, including rudimentary process dynamics and chemical kinetics.

4. Complete simulation of chemical kinetic systems, process development investigations and over-all processing system designs with control included.

Each respectively requires a larger and more versatile computer, as shown in Table II. The larger machines accomplish the tasks of the smaller; separate installations are not required, unless the workload of the larger machine necessitates it.

No computer has ever been big enough to handle all the problems which eventually are applied to it. As a result, computer facilities have continued to grow in size, flexibility and speed of operation. Fig. 1 is a graph in which criterion of size is the number of computer operational amplifiers. Both aircraft and chemical industries appear to show an equivalent exponential growth. There is as yet no end in sight for this expansion. The organization considering a computer installation should be sure that machine and installation are readily expandable when the need arises.

Using the Analog Computer

The analog computer seems the best device for

- Most probable reaction mechanisms and process kinetic parameters by evaluation of laboratory data.
- Optimum control systems for process equipment.
- Optimum equipment design from standpoint of dynamic behavior and automatic control.
- Optimum scheduling and operating conditions for reactors.

To do all this, note that the computers recommended in Table II have a high proportion of nonlinear gear, especially the larger machines. These recommendations are made because of the nature of chemical problems, particularly those involving chemical kinetics. A large number of multiplications and function generations, particularly exponential functions, are required.

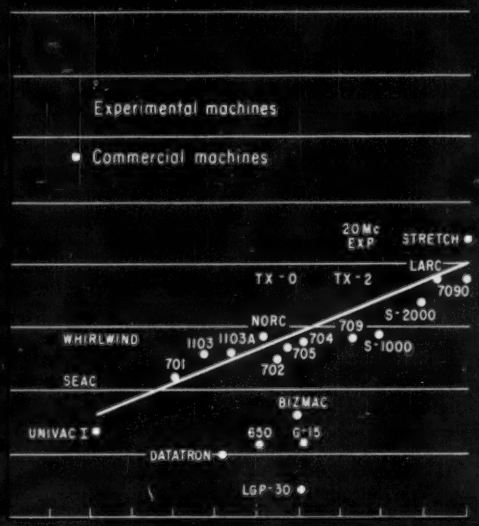
The large selection of operational relays and function switches permits direct simulation of multi-step processes, such as batch drying and crystallizations as a continuous operation. This avoids breaking a problem into many separate steps with attendant possibilities of error and difficulties of data correlation.

The component distribution of Monsanto's analog computer facility, including its latest expansion, is given in the last column of Table II.

Some points in the table bear emphasis. First, repetitive operation, used with oscilloscope display, permits the most extensive display of dynamics of a process or control system in the shortest possible time. For instruction, this continuous display demonstrates vividly the effect of changes in system parameters.

However, because of severe limitations on plotting accuracy, repetitive operation may be used for research and design problems only in "ball-park" estimations.

Second, the x-y plotter is an extremely flexible function generator, particularly useful for presenting such functions as temperature-variable heat transfer coefficients which cannot be presented readily by standard function generation equipment.



Graph courtesy of *Control Engineering*

As for personnel, electrical and mechanical engineers now have the best background in automatic control theory and the associated mathematics, but as the group delves more into process intricacies, the chemical engineer's knowledge becomes more important. Note that a certain number of electrical engineers are still recommended in larger installations because of their familiarity with computer operation and capability.

Full-time maintenance personnel are recommended only when the computer is large enough to demand such attention (50-100 operational amplifiers). For smaller machines, the engineers should perform necessary preventive maintenance checks and repairs.

Because of high depreciation charges, the economics of large-scale computers almost demands multi-shift use. The staffs in Table II are for two-shift operation of the largest machine recommended.

Because of the difficulty of training personnel and extreme complexity of the problems, the large computer facility should be operated on a "closed-shop" basis. However, it pays to obtain complete cooperation of the person originating each problem. Often he will have a feeling for the problem that will be invaluable in checking out the computer and evaluating final results.

New Analog Developments

Several recent or imminent developments in equipment and operating techniques promise to aid and maybe even revolutionize analog computer operation. Most involve digital techniques of some sort.

One need in analog computer operation is representation of a true time delay. Suitable and reasonably priced magnetic tape or drum mechanisms for this purpose would be a boon. Such devices are now under development.

Analog computers are designed for the solution of ordinary differential equations; digital computers are fast and accurate in solution of algebraic equations. Analogs have only rudimentary logic capabilities, but complex logic operations are carried out on digital machines. Joint use of these machines for solution of large process problems, which entail all three types of mathematical operation, appears to have potential. Devices to connect the two computer types during operation are in use by several defense system contractors, and models are also under development for use in the process industries.

Another need in analog computation is in simulation of distributed parameter systems and processes.* These systems require partial differential equations or large sets of simultaneous ordinary differential equations. Their analog solutions require large machines. However, if preliminary results can be stored during solution, a problem of this type can be solved on a much smaller analog machine by use of a readily programmed trial-and-error procedure. These devices are being developed by computer manufacturers.

Using Digital Computers

The digital computer, through its special facility with the algebraic operations, seems the best device for use by the process industries for

1. Steady-state designs for processing equipment, especially for that which normally requires trial-and-error procedures.

*For example, in a thermal system where individual resistances and capacitances are used rather than over-all.

2. Optimization of plant schedules and flow patterns to insure maximum return for the prevailing sales picture. Through operations research, such studies can be made for whole plant complexes or even complete companies.

3. Simulation of systems too large or complex for available analog computers.

4. Statistical analysis of plant operating data to determine plant control responses and aid optimization studies.

Because digital computers are available in only a few specific models, it is not as difficult to determine best installation size as it is for analogs. The best rule here is to procure the biggest and fastest machine that can be financed and staffed. (Digital computer organizations have, on the average, doubled in cost and number of personnel involved each 12-18 months.) As with analog computers, a company invariably underestimates the applications that will be made of the computer once it is installed.

Computer installations of the size necessary for such calculations as we will describe in this systems engineering series can be divided into two categories. Of the medium-sized computers, the Royal McBee LGP-30 is considered minimum size. These progress through the Bendix G-15 and the IBM 650 to the Burroughs 205. The large-sized computers start with the Burroughs 220 and IBM 7070, through the IBM 704 and 709 and Remington Rand Univac 1103A, to the RCA 501 and the IBM 7090. Fig. 2 shows the increasing speed of these machines.

Table III presents our opinions as to personnel required to adequately man digital computers of either size. Recommended personnel ranges allow for variations in computer size within each group. (Our thanks to Dr. Leon Cooper, manager of Monsanto's applied mathematics section, who prepared the digital computer history and staff requirements.)

The short but spectacular history of computers, the exponential increase in computer size and capacity and the only recent wide application to chemical and petroleum industry problems means that most major discoveries concerning their use are still ahead of us.

Systems Engineering and You

Monsanto believes that systems engineering has a significant contribution to make to the practice and development of chemical engineering. The crossing of barriers between chemical engineering and other engineering disciplines and the use of advanced mathematics to study fundamental process mechanisms cannot help but be fruitful. Study of transient and dynamic behavior will undoubtedly produce radically changed design methods and results. The use of computers and the development of mathematical process simulation techniques may result in completely new methods and approaches which will justify themselves by economic and technological improvements.

What we will do in this every-other-issue series is show with a specific, fictionalized example how systems engineering can be applied profitably. In the second installment, we will introduce you to fictional engineers in a fictional company who have an all-too-real problem: design and operation of a plant beset with a peculiar, complex "personality." The problems are in your language; their solutions may define what systems engineering can do for you.

REFERENCES

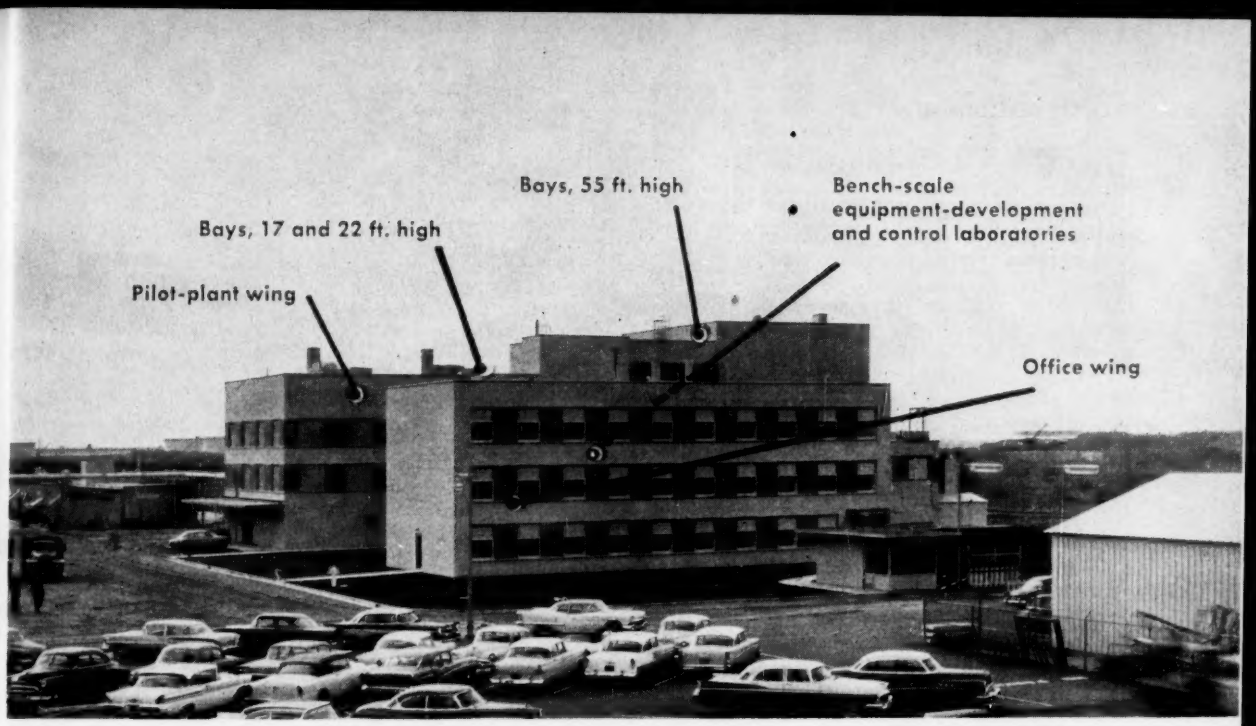
1. Ball, W. E., Parisot, P. E., Computer Report, *Chem. Eng.*, Sep. 7, 1959, pp. 126-44.
2. Goode, H. H., Machol, R. E., "Systems Engineering," McGraw-Hill, New York, 1957.
3. Lydersen, A. L., others, Generalized Thermodynamic Properties of Pure Fluids, Report 4, Engineering Experiment Station, University of Wisconsin, Madison, 1955.
4. Williams, T. J., Systems Engineering—Its Potential in the Process Industries, 14th annual symposium on instrumentation for the process industries, Texas A & M, College Station, 1959.

1959 Schoch Lecturer

THEODORE J. WILLIAMS is engineering supervisor, research and engineering division, Monsanto Chemical Co. Long interested in the areas that are now being circumscribed by systems engineering, Dr. Williams was lecturer at the 4th annual Schoch Lecture this past autumn—his topic: systems engineering for the process industries. Williams received his B.S. and Ph.D. in chemical engineering at Penn State. Later he took an M.S. in electrical engineering at Ohio State. He taught at the Air Force Institute of Technology, where he became interested in analog computer possibilities. He joined Monsanto following the tour of duty with the Air Force and organized the analog computer facility. His prodigious output of papers (over 50) on many aspects of process control, dynamics and analog computation attest to the growth of his philosophy on CPI systems engineering. A registered professional engineer, he is a member of AIChE, ASEE, ACS and Tau Beta Pi.

Schoch Lecture Series

EUGENE P. SCHOCH is professor emeritus of chemical engineering, The University of Texas. Founder of the chemical engineering department at that university, Schoch has a long list of articles, patents and texts to his credit. Best known in the CPI for his electric discharge process for hydrocarbons conversion (the acetylene process), he has also carried out research in water purification and use of lignite. The Schoch Lecture series was established and is supported by former students, as well as by industrial companies. Previous lecturers include W. K. Lewis (1956: fluidization of solids), D. L. Katz (1957: phase behavior) and R. H. Wilhelm (1958: reaction kinetics and reactor design). At the conclusion of T. J. William's 1959 Lecture (the basis for this series in *Chemical Engineering*), it was decided to continue the series for another five year period, starting in 1961. The 1959 Schoch Lecture will appear in every other issue of *CE* this year.



How to House Process Development

Development engineers and research managers will want to join this tour-in-print through Standard of Indiana's newest R & D building.

GEORGE W. SCHUSTEK, JR., Research and Development Dept., Standard Oil Co. (Indiana), Whiting, Ind.

WELCOME to the Process Development Building, newest unit of our Whiting Research Laboratories.

Naturally we're quite proud of our new house and we're delighted that you're able to take this tour through it. But our main reason for publishing this article is to acquaint you with some of the basic design problems in planning a building that adequately houses all the functions of a process-development organization.

While gathering ideas for implementing such a design we received many helpful suggestions from other companies in the chemical process industries; and we, in turn, would now like to pass along our experience to others for whatever help it may be to them.

Two main factors led to our decision that all the functions of process development should be housed in a single structure:

1. Experience has indicated that geographic separation of development functions leads to impaired communications.

2. Expansion of research and development activities creates the need for additional space of all types. In designing for this, close attention must be given to safety and to effectiveness of communication and supervision.

Three Main Functions

Three functions are to be performed in a process-development building:

- Operation of pilot plants.
- Laboratory work.
- Office and desk work.

Recognition of these three distinct functions led us to the planning of three wings for the new building arranged in the form of a lower-case "h." The pilot-plant area is close to the neighboring mechanical shops building; the office wing is as close as possible to other laboratory and office buildings; and the laboratories are between pilot plants and offices.

When fully occupied, the three-story building with a total floor area of 57,500 sq. ft. will house 20 major pilot plants and the activities required to support them. Professional staff will number 60, with a supporting staff of 25 in the offices and 110 in the labs.

Pilot-Plant Wing

Key function of process-development work is experimentation on the pilot-plant scale. To accommodate the variety of equipment that

might be needed, several types of buildings were studied.

We rejected a single-story design because it uses land inefficiently, and makes communications unwieldy. A multiple-floor building with open sections or removable gratings in the upper floors was rejected because of the possibility of spilling materials onto the lower levels.

The present combination, with solid flooring, seemed most practical and efficient.

Ceiling clearances of 17 ft., 22 ft. and 55 ft. are provided in various parts of the pilot-plant wing to accommodate units of any likely size. Spaces available for such pilot plants are:

Bays	Sq. Ft.	Headroom
5	5,075	17 ft.
9	6,525	22 ft.
4	2,900	55 ft.

The 22-ft. height of the first story places the second floor, with its 17-ft. ceiling, level with the third floor of the laboratory and office wings. The four bays with 55-ft. headroom are in the west end of the wing.

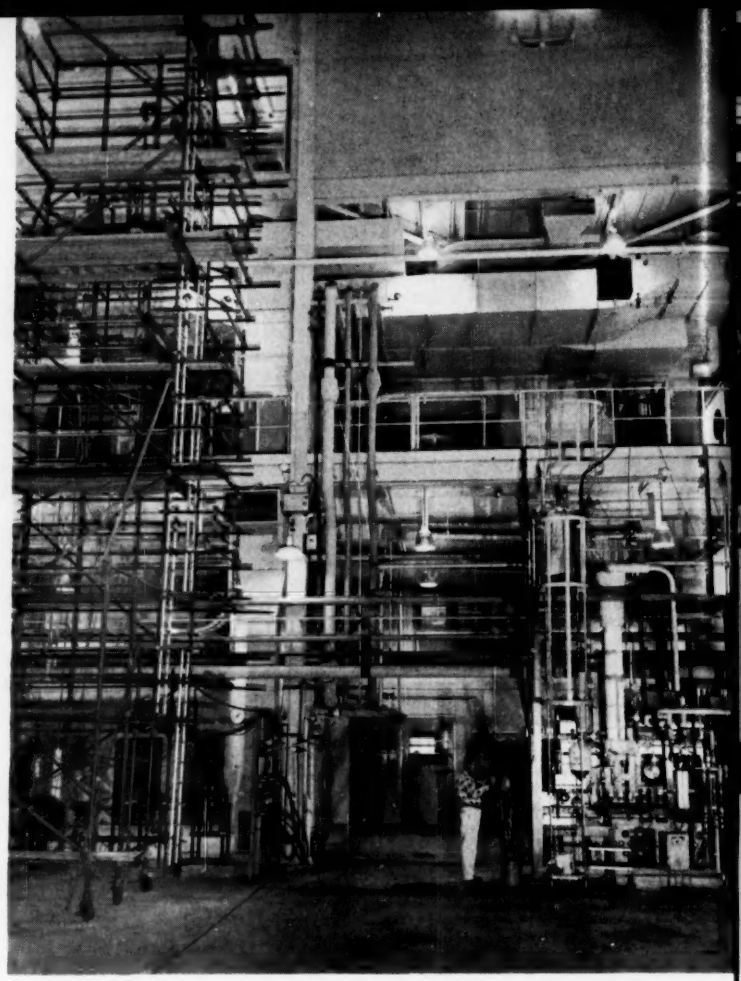
All pilot plants are supported from the reinforced-concrete floors, which are designed to support live loads of over 200 lb./sq. ft.

Utility headers are connected to the main supply through risers at each end of the building, so that heavy demands by any one pilot plant will not starve an adjacent unit. This looping contributes to flexibility by permitting the shutting down of portions of the building when necessary, without interrupting service to the entire wing.

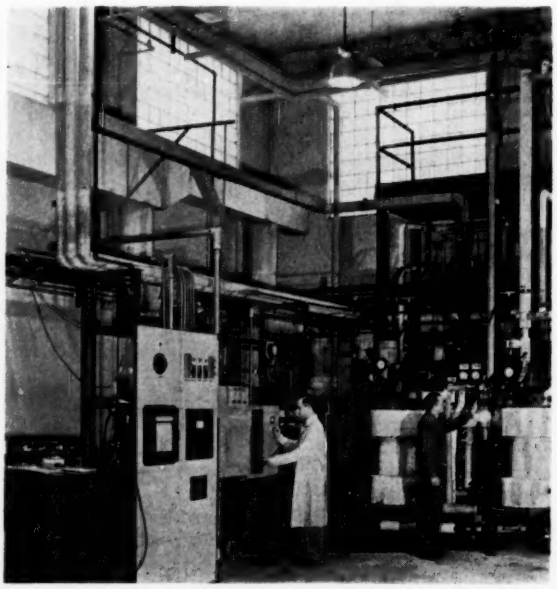
Process utilities provided are: 100-psi. steam; process water; fire-fighting water; 100-psi. air; 500-psi. nitrogen; and 120/208-volt electricity.

Safe disposal of wastes presents special problems. We use three types of drains. Four general-purpose drains of 14-in. dia. are provided in each bay; the floor is pitched 1 in./10 ft. so that spilled liquids will be discharged quickly. Additional drains near the exterior walls receive cooling water from equipment that cannot conveniently be located over the center floor drains.

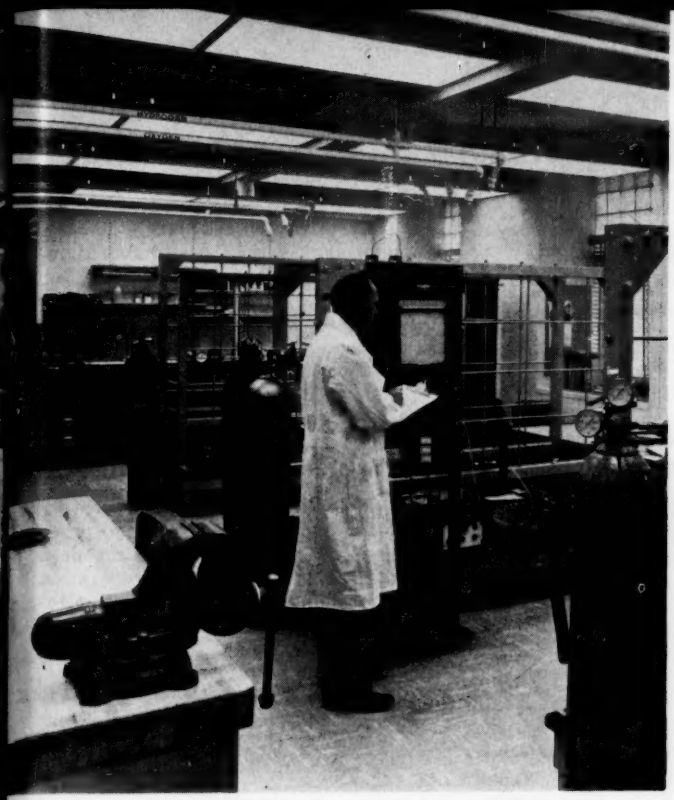
A separate closed-drain system accepts condensate from steam-heated equipment without the nuisance of escaping vapors. Pipe sleeves through the exterior walls



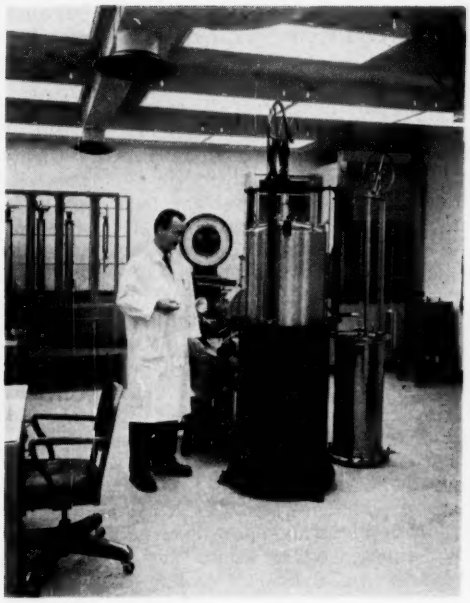
1 HIGH-BAY area serves pilot plants that study catalytic cracking.



2 22-FT. HEADROOM, sufficient for naphtha pilot plant.

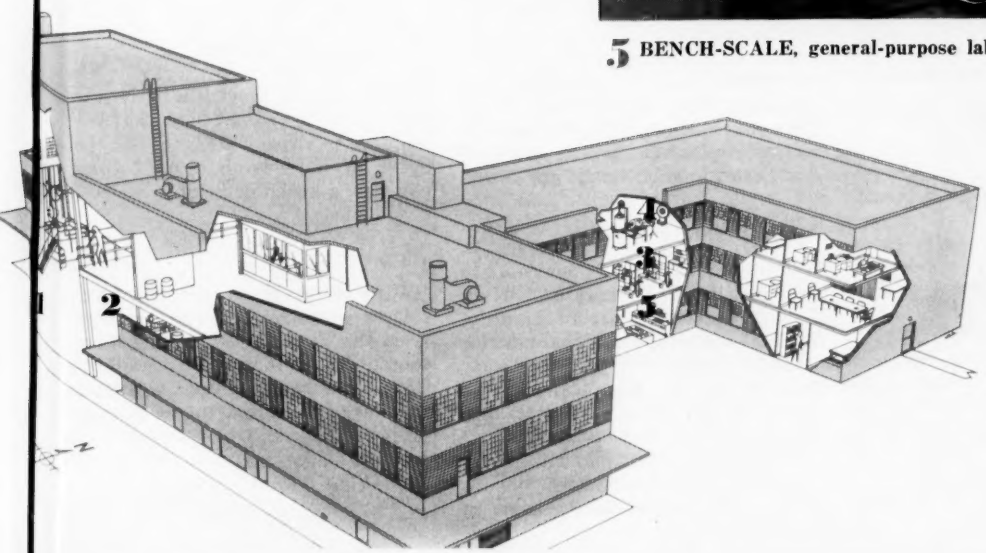


EQUIPMENT DEVELOPMENT is an important staff function.



4 CALIBRATION of gas flow rates.

5 BENCH-SCALE, general-purpose laboratory.



near the ceiling of both floors permit high-pressure relief devices to discharge outside the building.

At about a dozen locations, openings of 1-2 sq. ft.—protected by a concrete curb—were left in the second floor and in the roof. They provide general flexibility for such possible uses as operating pilot plants on lower and upper floors in an integrated process, or venting noxious fumes above the roof.

Key safety features in the pilot-plant wing are the ventilating system and the plentiful floor drains. Because many of our pilot plants must run with parts well above ignition temperatures, explosion-proof wiring would not offer practical protection against fire. Instead, an effort was made to preclude the accumulation of explosive atmospheres.

Twelve changes of air each hour are made in normal operation, with 18 changes available in the case of spills or for additional cooling in hot weather.

Only filtered, fresh air is used. None is recycled, so vapors cannot be transferred from one part of the building to another.

To accommodate experiments of a semi-pilot-plant nature—experiments that require equipment larger than bench-scale, but not as large as a complete pilot plant—a room is partitioned off at the east end of the second floor.

Pilot-plant operations are directly supervised by foremen from a glass-enclosed office at the center of each floor. Telephones are provided at several locations in the pilot-plant wing. A paging system enables the building receptionist or the foremen to call people at work on the process floors.

GEORGE W. SCHUSTEK, JR., has been with the Standard Oil Co. (Ind.) since 1946. He is now section leader in the process development division of the research and development department at Whiting. Schustek is a state-registered engineer in Illinois and a member of AIChE and ACS.

The Laboratory Wing

Operation of pilot plants generates a wide variety of incidental activities. They may include treatment of feeds, catalysts or products; preparation of samples for analytical work; or small-scale experimental work for the guidance of pilot-plant operation. The air-conditioned laboratory wing, containing 11 double-bay laboratories 20-ft. square and three equipment labs, meets these needs.

Each general-purpose laboratory is equipped with standard laboratory benches and two fume hoods which exhaust above the roof of the building.

Equipment laboratories handle work related to selecting, developing and calibrating instruments and other devices useful in running pilot plants. This work has grown in recent years to a position of prominence in our process-development activities.

In one equipment laboratory, deficiencies in new commercial equipment are detected and corrected and new types of equipment are developed for special applications. The second laboratory contains instruments needed for work on electronic devices. The third equipment lab is devoted to calibration work.

Here, temperature and flow instruments can be calibrated against primary standards, conveniently and as frequently as needed for precise work.

Reached through the laboratory stockroom is an equipment area on a mezzanine of the pilot-plant wing. This area holds spare parts for common pilot-plant equipment and used equipment in good condition.

Special Safety Devices

Two special safety devices are provided in the laboratory wing. Escape hatches interconnect adjacent laboratories near the exterior walls; in case of a flash fire, men trapped in the room can open a panel by touching a button and escape into the next room.

Also, an automatic alarm guards against the abandonment of any person who might be overcome by fumes while working in the special low-temperature room.

On the first and third floors of the laboratory wing, adjacent to the pilot-plant wing, are three single-bay offices. These house the project engineers directly responsible for operation of the pilot plants. This location gives these men the easiest possible access to the pilot plants for frequent contact with the operators.

The Office Wing

The chief purpose in operating pilot plants or performing other experiments is to obtain data needed in the design and operation of commercial plants. Much planning and many calculations are required to design effective experiments and to interpret experimental results.

These functions are carried out in the air-conditioned office wing. Thirty-nine offices, each about 10 ft. by 15 ft., are occupied by technical supervisors, chemical engineers, and clerical and stenographic assistants.

In general, supervisors have private offices; nonsupervisors share offices with one other person. The office nearest the stairway on each floor is occupied by a secretary, who serves as receptionist for that floor.

Two conference rooms are provided in the office wing. One is used largely for discussions with visitors. A large conference room occupies the space of four office bays on the second floor; folding partitions permit holding two meetings simultaneously.

This ends our tour of the largest and newest of the four process-development buildings at Standard's Whiting laboratories. Although only in service a relatively short time, we have found that the building is already serving well the needs of a research minded company in a technologically progressive industry.

ACKNOWLEDGEMENT

We wish to acknowledge the helpful suggestions that we received from the Pure Oil Co., Sinclair Research Laboratories, Inc., and the Corn Products Refining Co. during the early planning stages of our design.

REFERENCE

Friden, J. E., and T. G. Stack, *Chem. Eng. Progr.*, **50**, p. 151 (1954).

Use Capital Ratio

$\frac{\text{Invested dollars}}{\text{Sales dollars}}$

- To keep investment/sales in line
- Avoid over engineering
- Catch errors in estimates

LAWRENCE LYNN and R. F. HOWLAND, Engineering Research and Commercial Development Laboratory, General Foods Corp., Tarrytown, N. Y.

How can we best distribute our capital among our various activities? As companies grow bigger to remain competitive, as the minimum economical size of company operations increases, this question in management minds becomes more and more pressing. There is a need for tools that will help answer the question if answers are not to be based on hunches or guesstimates.

Capital ratio is one such tool for rapidly sizing up or screening investment alternatives. Though it can be helpful in assisting management to make order-of-magnitude appraisals, it is not used as widely or as often as it might be. This neglect stems in part from a lack of data and a lack of awareness concerning its usefulness as a screening tool, and in part from inherent limitations in its reliability.

Capital ratio can be defined most simply as the ratio of fixed investment capital to annual sales volume for a given company. The inverse of capital ratio is the ratio of sales value to unit investment. This ratio, usually called turnover ratio, is sometimes used as a measure of the rate of sales generation by capital.

With accurately known capital ratios for various industrial activities, you have a basis for making quick order-of-magnitude capital cost estimates. Ideally, you can approximate the capital investment required for a venture by projecting sales prices and volume—the sales rate—and then multiply the annual sales rate by the capital ratio applicable to the industry involved. You can also use known capital ratios for quick checks on more careful estimates of either capital or volume. We will discuss these and other applications for capital ratio.

The thesis that capital requirements for process industry ventures can be related to the annual value of products produced is not new. Over a generation ago, Tyler[1] mentioned that the average investment in chemical plant facilities was about \$1 per dollar of sales, with a spread from about \$0.75 to \$1.25 per dollar of sales. More recently, Nichols[2] and Schweyer[3] suggested that, if the desired annual capacity and market value were known, one could approximate the necessary capital value. Kiddoo[4] pointed out that the nature of the product, the maturity and stability of the market and other factors affect the turnover ratio for various chemical investments.

In our study[5] for the period 1939 to 1952, we showed that the capital ratios for different process industries could be statistically correlated within reasonable confidence limits. However, the average capital ratio for this period—1.27—included such diverse values as 2.51 ± 0.30 for petroleum and 0.48 ± 0.07 for soaps and detergents.

We have undertaken the present study to appraise capital ratio for essentially the same group of industries as we covered in the 1939-1952 study, but over a more recent time period. We wanted to compare recent capital ratios with previous ones to determine if and where changes might have occurred. We also wanted to learn whether or not any trends in capital or turnover ratio exist over recent years and, if so, whether the trends are uniform or non-uniform among the various process industries.

Definitions

We will define capital ratio, R, as the ratio of current or required real value, C, of total plant to the volume, S, of business which we might expect from the investment fixed in this plant.

Obviously, both the investment and the sales volume must be expressed in monetary units of the same year. Here, we consider capital as the estimated replacement value for a given year of the facilities normally included in fixed assets. In general, it is this investment which would have to be allocated and made in up-to-date dollars when considering a major expansion, entry in a new field, or acquisition versus its alternatives.

Thus capital, to a large extent, is made up of money invested in land, production facilities, warehousing and other manufacturing

Successive Studies Show Gradual Rise in Capital Ratio, Variance by Industry—Table I

	1939–1952 Period			1948–1958 Period		
	Average[2] capital ratio	S.D.[3]	Number[4] of Cases	Average capital ratio	S.D.	Number of Cases
Chemicals, general[1]	1.25	0.36	310	1.67	0.69	297
Carbon black	3.37	0.41	21	3.73	0.04	22
Explosives	1.20	0.17	20	1.33	0.06	22
Glass	0.97	0.29	40	1.09	0.36	55
Fibers, synthetic	1.79	0.30	51	2.40	0.68	44
Foodstuffs processed	0.63	0.39	72	0.61	0.34	88
Inorganics, heavy	2.06	0.79	129	2.04	0.84	143
Nonferrous metals	1.87	0.90	84	2.37	1.26	66
Petroleum	2.51	0.30	75	2.53	0.70	88
Pharmaceuticals	0.53	0.15	138	0.82	0.45	110
Pigments, paints, inks	0.70	0.31	55	0.81	0.33	55
Pulp and paper	1.74	0.34	69	1.77	0.39	77
Resins and plastics	0.77	0.29	61	1.55	0.92	55
Rubber	0.75	0.15	38	0.77	0.25	55
Soap and detergents	0.48	0.07	18	0.66	0.01	22
Steel	1.60	0.38	70	1.96	0.51	55
Sulfur	1.12	0.34	20	1.17	0.58	22
Average	1.37		1271	1.61		1276

components. However, we must also include in "plant" the research and development facilities needed to support the operation (even at maturity), the administrative facilities and elements of the distribution system including, in some cases, captive transportation facilities. Investments in these and other related nonmanufacturing components are all necessities for supporting sales positions in business today.

It is important to include these factors when considering a realistic picture of the total fixed assets in a given venture. This is true even though some of these items are not always included in many detailed engineering estimates, but persist rather malevolently in making their appearance via the overhead route.

By sales in capital ratio, we mean net sales volume per year. Net sales volume means the total annual sales less cash discounts, the value of returned goods and similar items, taken over the calendar or fiscal year depending on the practice of the particular company studied. Where possible, we obtained this information from annual reports or other published financial data.

Scope and Bases of Study

This study covers the period from 1939 to 1958. We have determined capital ratios for 17 process industries or industry groupings based upon the data published by 114 major companies during this period. The fact that large and relatively integrated companies were included in the survey may introduce a limitation on the validity of the results—especially if they are taken as an indicator for small projects or companies. However, we did not feel that determination of a size bias effect on the results was within the scope of this study.

We selected companies on several bases. These were:

- Accessibility of product and financial data.
- Size in an absolute sense and relative to its industry. In general, preference went to the largest and most representative companies.

In some process industries, such as rubber products, we found that a sampling of only five companies was enough for industry coverage and for a consistent capital ratio with reasonable standard deviations. In the case of general chemical manufacturing, on the other hand, we expanded the industry sample to 30 companies because of both the size and complexity of the industry and the wide diversity of product lines and technologies represented.

The listing on page 135 shows the companies included in the survey and the industry groupings. As you might expect, grouping of companies by process industry type often is not simple because a single company may participate in many widely diverse areas. For example,

1953–1958 Period			1958[5]		
Average Capital ratio	S.D.	Number of Cases	Average capital ratio	S.D.	Number of Cases
1.76	0.71	162	2.02	0.68	27
3.76	0.30	12	3.98	0.45	2
1.42	0.01	12	1.64	0.02	2
1.17	0.40	30	1.46	0.57	5
2.84	0.90	24	3.44	1.08	4
0.63	0.32	48	0.66	0.26	8
2.04	0.90	78	2.24	0.75	13
2.57	1.38	36	3.31	1.68	6
2.71	0.76	48	3.08	0.91	8
0.91	0.58	60	0.92	0.58	10
0.88	0.32	30	1.04	0.41	5
1.81	0.38	42	2.01	0.56	7
1.74	1.14	30	1.90	1.01	5
0.82	0.27	30	1.04	0.41	5
0.72	0.01	12	0.69	0.09	2
2.08	0.56	30	2.78	0.73	5
1.35	0.59	12	1.97	0.65	2
1.72		696	2.01		116

References to Table I

1. See list for companies included in each grouping.
2. Ratio of estimated replacement value at the given year for all facilities normally included in fixed assets to net sales for the same year.
3. Standard deviation, during period stated, for capital ratios.
4. Company-year cases used to compute average capital ratio for period stated.
5. Calendar or fiscal depending on company usage.

Abbot Laboratories is easily classified in "pharmaceuticals." Similarly, despite some diversification, General Foods is as readily classified under "foods, processed." But with Celanese, which produces synthetic fibers ($\frac{2}{3}$ of sales), a wide line of organic chemicals ($\frac{1}{3}$ of sales) and plastics (the remaining $\frac{1}{3}$ of sales), classification is difficult. We considered each company individually and classified it into one or more categories. These classifications were based upon either an analysis of assets and sales, when the composition of these factors was available, or on the character of its major product lines when insufficient data for analyses were available.

Primary data sources included standard financial references,[6-9] annual industry summaries,[10-12] and the *Engineering News Record*[13]. We supplemented these sources with information from the annual reports of the individual companies.

With the index corrections of the *Engineering News-Record* construction cost index, we corrected the total fixed assets for a given company to the undepreciated replacement values for each year during the period considered. Money invested in new fixed assets during any given year, where not reported per se, was determined by the difference between reported fixed assets for the given year and the prior year. New funds so invested were not corrected by index since the value of the dollar in the year these funds were invested should be equal to the dollar expressed in net sales.

Relative Trends In Capital Ratios, 1948–1958 **Table II**

	Relative Slope, Capital Ratio vs. Time
Foodstuffs, processed	1.0
Rubber	1.4
Pulp and paper	1.5
Pharmaceuticals	1.8
Soap and detergents	2.1
Carbon Black	2.2
Glass	2.4
Pigments, paints and inks	2.5
General chemicals	2.6
Explosives	3.6
Steel	4.3
Inorganics, heavy	4.5
Nonferrous metals	4.6
Petroleum	5.0
Sulfur	5.0
Resins and plastics	5.4
Fibers, synthetic	10.0

Thus the calculation followed the general equation below:

$$R_n = (C/S)_n = \frac{(C_{n-1})\, i + \Delta C}{S_n}$$

Where C = fixed assets, $.
S = net sales, $.
R = capital ratio
n = calendar (or fiscal) year for R.
$n-1$ = previous calendar (or fiscal) year.
i = construction cost index correction from year $n-1$ to year n.
ΔC = change in C from year $n-1$ to year n.

Replacement value of facilities in operation in 1939, built or acquired prior to 1939 but expressed in 1939 dollars, was estimated from general information on the type and age of these assets in 1939 and from the *ENR* indexes prior to 1939. Since precise information from years before 1939 was often not available, this approach introduces an indeterminate error. Where a company had a large percentage of its present assets in operation before 1939, the error will be greatest, but if the company expanded greatly during the 1940's and 1950's, this initial error in the 1939 replacement value is not significant. The error is particularly small in R_n values for the later years.

We considered the value of R_n for any company during any year over the period chosen as one company-year case. For each year, we averaged R_n for all cases in each industry category to obtain R_n for the industry in that year. Since in our previous study[5] we statistically checked compilations of both total assets to sales and fixed assets to sales, we included all years and all cases in this study. Table I gives

the resultant values of R by industry for the time periods chosen.

R Varies by Industry

As you can see from Table I, the rule of a dollar of capital per dollar of sales no longer holds—at least, not for the chemical process industries. Table I also shows that there is no good average value of R for the process industries. This is especially true for recent periods. For example, for the 1953-58 period, there are values as low as 0.6 for processed food products and up to 2.8 in synthetic fibers and 3.8 in carbon black.

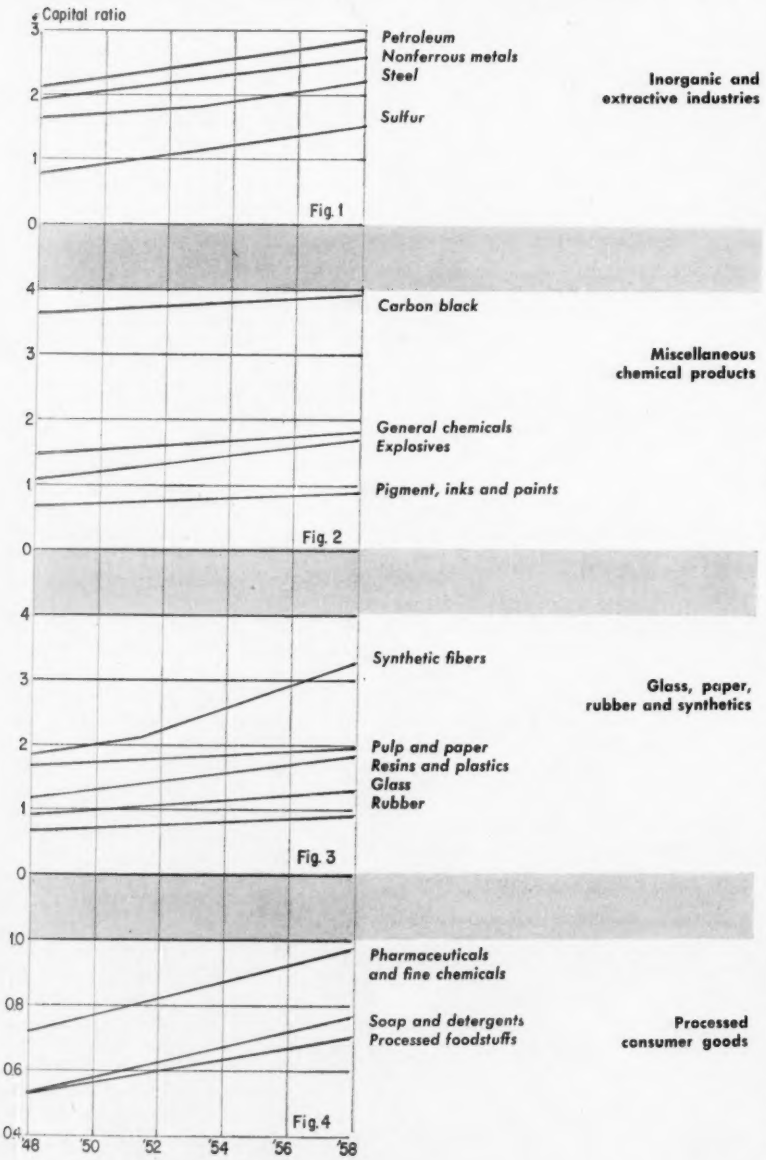
Though we developed no correlation, and doubt that any really rigorous correlation can be developed, it is evident that a number of factors indicate whether R will be high or low for an industry. Generally, R will be high, more than 2.0 for 1958, in the following cases:

- Very large volume operations, producing low unit sales value items, are typical to the industry —there are few small operators. These are usually the industries that are the most difficult for the nonparticipant to enter. Examples might include aluminum, steel, petroleum and newsprint pulps.
- Operations are technologically complex. This complexity extends to the distribution pattern for sales as well as in raw materials handling and production. There is heavy dependence upon aggressive, broad research and development programs aiming at new processes and products, but successful investments of effort lead to handsome payoffs. Novelty and rapid obsolescence create an urgent need for flexibility in facilities. Examples include plastics, heavy organic chemicals, synthetic fibers and petroleum.
- Products produced by high R value operations are workhorse items furthest removed from the consumer. Many undergo much further processing, such as heavy inorganic chemicals, nonferrous metals, and carbon black.
- There tends to be a high degree of vertical integration among successful participants which extends to most of the significant raw materials. Again we might cite the synthetic fiber, petroleum, copper and aluminum industries.

Aside from the inverse of the above characteristics, there are several other factors that tend to exist where R values are low—below 1.5 for 1958. These factors would include:

- Total size of the industry may be large, but there are many companies engaged in it, some of them small regional businesses. These industries have the most diverse product lines and contain many successful small companies as well as large enterprises. Profit margin on the sales dollar is frequently small. Industry domination is rare or impossible because of the scatter of participants in size, geography, and product line. Examples might include food products, pharmaceuticals, pigments, paints and inks.
- Relatively speaking, the operations are not technologically complex. Even where scientific complexity exists, processing requires comparatively simple equip-

Increase in R and Industry Variations Easily Seen in Graphs



ment, such as kettles, or transformations are by physical rather than chemical means. Here we might include glass products, pharmaceuticals and rubber products.

• Operations produce relatively low volume specialty products, frequently with high unit sales value, such as inks, pharmaceuticals and fine chemicals.

• Products produced in these operations are relatively close to the consumer. These would include soaps, detergents and food products.

What Are the Trends?

Besides identifying recent capital ratios for various industries, we wanted to find out if there was a trend in capital ratio over a period of time. Assuming such a trend to exist, we were interested in learning whether this trend was relatively uniform or divergent from industry to industry.

We charted average R_n values by year for each of the industries or groupings shown in Table I. Figs. 1 through 4 show the curves for the period 1948 through 1958. The R_n vs. time curves in this period are almost straight line extrapolations of the earlier 1939-1948 curves with only rather small divergence during the World War II years.

You can see from these charts that there is a trend for R values with time and that it is a persistently upward trend. The trend is up, we believe, because of inflation in the cost of facilities rather than in the products they produce. We base our belief on the nature of the increase and its variation from industry to industry. This phenomenon is closely related to the profit squeeze.

Another factor that increases R values is the tendency toward higher quality, including aesthetic considerations, in new facilities. Landscaping, cafeterias, complex waste disposal systems and more costly materials of construction all contribute to this trend. Architecture is an important first cost.

These considerations, however, do not explain the widely variant rates at which R has been increasing in different industries. In some instances, it has been a sharp and steady increase, even an accelerating increase in a few industries, while in others the increase has been small to almost indiscernable.

Survey Covered 132 Companies in 17 Different Industry Groupings

Chemicals, general
Allied Chemical and Dye
American Cyanamid
American Potash
Celanese Corp. of America
Commercial Solvents
Davison Chemical*
Diamond Alkali
Dow Chemical
E. I. du Pont de Nemours
Eastman Kodak
Food Machinery and Chemical
General Aniline and Film
Hercules Powder
Heyden-Newport
International Minerals and Chemicals
Koppers
Olin-Mathieson Chemical
Merck
Minnesota Mining and Manufacturing
Monsanto Chemical
Pennsalt Chemical
Pittsburgh Plate Glass
Pfizer, Chas. and Co.
Pittsburgh Coke and Chemical
Publicker Industries*
Rohm and Haas
Tennessee Products and Chemical*
Union Carbide and Carbon
Victor Chemical
Virginia-Carolina Chemical

Carbon black
Columbian Carbon
United Carbon

Explosives
Atlas Powder
Hercules Powder

Fibers, synthetic
American Viscose
Celanese Corp. of America
E. I. du Pont de Nemours
Industrial Rayon
North American Rayon*

Foodstuffs, processed
Borden
Corn Products Refining
General Foods
General Mills
Penick and Ford
Pillsbury Mills
Quaker Oats
Standard Brands

Glass
Anchor-Hocking
Corning Glass Works
Libby-Owen-Ford Glass
Owens-Illinois Glass
Pittsburgh Plate Glass

Inorganics, heavy
Air Reduction
Allied Chemical and Dye
American Agricultural Chemical
American Potash and Chemical
Davison Chemical*
Dow Chemical
Diamond Alkali
E. I. du Pont de Nemours
Hooker Electrochemical
International Salt
Olin Mathieson Chemical
Lindsay Chemical*
National Lead
Pennsalt Chemical
United States Potash*
Union Carbide and Carbon

Nonferrous metals
Aluminum Co. of America
Aluminum Ltd.
American Smelting and Refining
Anaconda
Kaiser Aluminum and Chemical
Kennecott Copper
Reynolds Metal

Petroleum
Atlantic Refining
Cities Service
Phillips Petroleum
Shell Oil
Sinclair Oil
Socony Mobil Oil
Standard Oil (Indiana)
Standard Oil (New Jersey)
Texaco

Pharmaceuticals and related products
Abbott Laboratories
American Cyanamid
American Home Products
Bristol-Myers
Heyden-Newport Chemical
Mead Johnson*
Parke, Davis
Pfizer, Chas. and Co.
Sharpe and Dohme*
Squibb, ER and Sons*
Sterling Drug
Vick Chemical

Pigments, inks and paints
Eagle-Picher
Glidden
Interchemical
National Lead
Sun Chemical
St. Joseph Lead*
Sherwin-Williams*

Pulp and paper
Champion Paper and Fibre
Crown-Zellerbach
Kimberly-Clark
International Paper
Marathon*
Rayonier
St. Regis Paper
West Virginia Pulp and Paper

Resins and plastics, synthetic
Catalin Corp. of America
Celanese Corp. of America
Dow Chemical
E. I. du Pont de Nemours
Durez Plastics and Chemicals*
Rohm and Haas

Rubber
Firestone Tire and Rubber
Goodrich, B. F.
Goodyear Tire and Rubber
General Tire and Rubber
United States Rubber

Soap and detergents
Colgate-Palmolive
Procter and Gamble

Steel
Bethlehem Steel
Crucible Steel
Inland Steel
Republic Steel
United States Steel

Sulfur
Duval Sulfur*
Freeport Sulphur
Texas Gulf Sulphur

* Included only through 1952

We assumed straight line behavior for R_n vs. time and tabulated the slopes of these industry curves for easy comparison. Table II, on page 133, shows these slopes for the 1948-1958 period on an arbitrary 1 to 10 scale where 10 represents the sharpest rate of increase in R_n.

Table II shows that, with some exceptions, those industries with the highest initial R values have the highest slopes. It appears that the more complex the industry, the more rapid the pace with which this industry is becoming even more complex because of higher capitalization per worker, more technologically complex processing, higher volume requirements, and so forth. Difficulty of entry probably parallels the R trend.

Careful scrutiny of the variant R trends reveals a number of factors that separate those industries or operations with rapidly increasing R from those in which the rate of increase is much smaller. Generally, R increases rapidly where:

• Technology is developing rapidly with larger volume units,

lower unit costs and a major trend toward automation.

• Labor is either more strongly organized or labor union pressures are greatest.

• In special cases, recessionary tendencies during a large part of the period and/or import trade from low cost areas have restrained and may continue to restrain the price of goods.

As with the absolute value of R, there are recognizable factors common to industries where the rate of increase in R has been lowest:

• The industries, and the main products and operations in them, are relatively mature. The impact of technology either has not been major, cannot be dominant, or has not started to strongly assert itself for most of the industry's participants.

• The industry is very large and composed of many small as well as large companies. The product line is comparatively stable. Ease of entry, at least regionally, with small capital permits sharp price competition.

• The product line is close to the consumer. This factor exerts strong pressures on product price.

R. F. Howland L. Lynn

ROBERT F. HOWLAND, B.S. in Chemical Engineering, Brooklyn Polytechnic, 1954; M. Ch. E., N. Y. U., 1958. He has been with General Foods Research Center since 1954, spending most of his time on research economics. Mr. Howland is now project leader in a group in the Engineering and Commercial Development Laboratory concerned with economic analysis.

LAWRENCE LYNN, (B.S.) ('48) and M.S. ('49) in Chemical Engineering, Columbia. After various assignments with Celanese Chemicals, he was briefly Group Leader, Exploratory Economics Group at Larkwood, Tex. Later, he headed Celanese Plastic's Plant Engineering Section and was Manager of the Economic Planning Dept. for Celanese Plastics Division. In 1955, Mr. Lynn joined General Foods Engineering and Commercial Development Laboratory as Ass't. Director and is now Laboratory Director.

How to Use Capital Ratio

Assuming its limitations are not exceeded, capital ratio presents management with an effective tool for first or rough-cut screening of proposed ventures. Whether the problem at hand is a possible internal expansion, a venture into a related or new field or an expansion by acquisition, questions of capital needs and factory door cost arise early. Known R values can assist in establishing order-of-magnitude estimates for each situation.

Some Examples

Assume you want to expand your operations, integrating vertically backwards toward several large volume inorganic chemical raw materials, A, B and C. Knowing the volumes required, V_A, V_B and V_C, and the price of these raw materials, P_A, P_B and P_C, we may derive the sales rate. With the capital ratio, R, for inorganic heavy chemicals, we can approximate the fixed capital investment needed thus: $C_{ABC} = R_{ABC}\,(P_AV_A + P_BV_B + P_CV_C)$.

If we know how these raw materials are derived, the price of the basic materials needed and the yields involved, we know the materials cost of A, B and C. But to know the factory door cost of A, B and C, we must know the cost of labor, maintenance, depreciation, utilities and services, taxes and insurance and plant general overhead.

If we know that the raw material cost is high, we can quickly estimate the unit costs for all fixed charges. We can estimate a rough factory door price for A, B, and C from our approximation of C_{ABC} above and from a general acquaintance with depreciation rates, maintenance costs, labor costs and so forth in the industry as a percentage of plant cost.

Suppose a detailed process engineering estimate or perhaps a final engineering capital request has been prepared for a proposal undergoing consideration. We can rapidly check this detailed estimate for reasonableness by comparison with competition as measured by the R value for this type of industry. We may now ask selected questions based on this check. Is the estimate reasonable or has the installation been over-engineered? Does the estimate appear too low because of the ommission of some important element not within the scope of the engineering assignment? Is the sales volume target too conservative for a reasonable production cost, considering the high capital per unit sales required?

Watch the Limitations

In using capital ratio, you should observe a few precautionary points.

1. Capital ratio is not valid for estimates of new plant investment in modifications to existing facilities, or in improvements or small additions to existing plants.

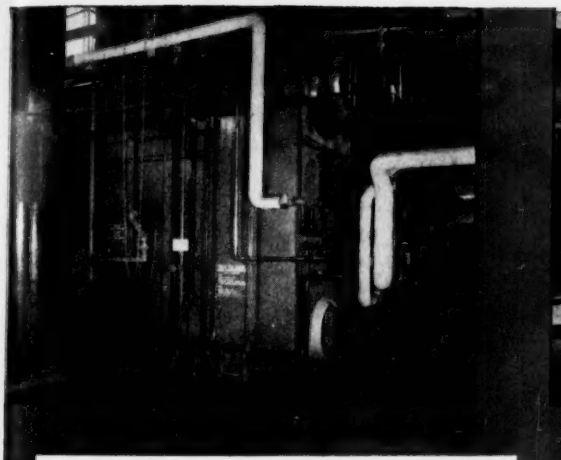
2. If old facilities, salvage equipment or rented facilities form a major part of the intended venture, capital ratio should not be used to approximate new capital needed.

3. You must consider not only the type of company or industry but also the type of operation which may or may not be typical for the given industry. A food processor building a new gelatin operation would be constructing a general chemical type plant rather than a processed foods facility, hence using the R for processed foods would be misleading.

Finally, estimates of capital requirements or factory door costs derived from capital ratio are inherently only approximations or checks for validity. They do not take the place of the more detailed and carefully prepared estimates that are the necessary bases for final decisions by management.

REFERENCES

1. Tyler, C., "Chemical Engineering Economics," 2nd Ed., p. 51, McGraw Hill, N. Y., 1938.
2. Nichols, W. T., *Chem. Eng.*, June 1951, pp. 248-50.
3. Schweyer, H. E., *Chem. Eng.*, Jan. 1952, p. 164.
4. Kiddoo, G., *Chem. Eng.*, Oct. 1951, p. 145.
5. Lynn, L., *Chem. Eng.*, Apr. 1954, pp. 175-6.
6. Moody's Industrial Manual. American and Foreign. 1954-1959. Moody's Investors Service, New York.
7. Moody's Manual of Investment. American and Foreign. Industrial Securities. 1946-1953, Moody's Investors Service, New York.
8. Standard and Poor's Corporation Records, 1939-1952, Standard and Poor's Corp., N. Y.
9. Monthly Stock Digests (various in 1959), Data Digests, Inc., N. Y.
10. Anon., *Ind. Eng. Chem.*, **42**, 948-73 (1950).
11. Anon., *Ind. Eng. Chem.*, **44**, 1209-22 (1952).
12. Anon. *Ind. Eng. Chem.*, **46**, 1094-1108 (1954).
13. *Engineering News-Record*, "Construction Cost Trends," Reprint from 20th annual report on construction costs (10/17/57).



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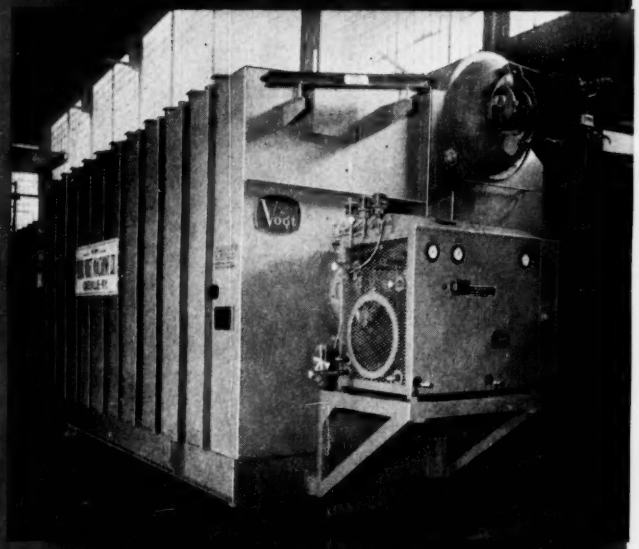

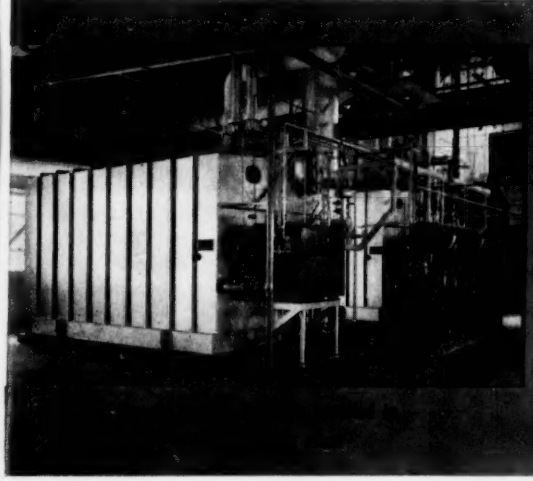

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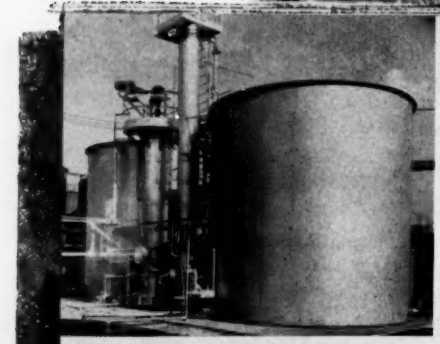

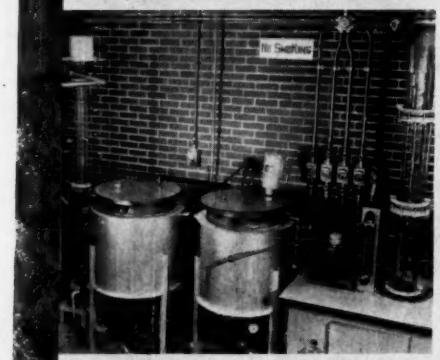

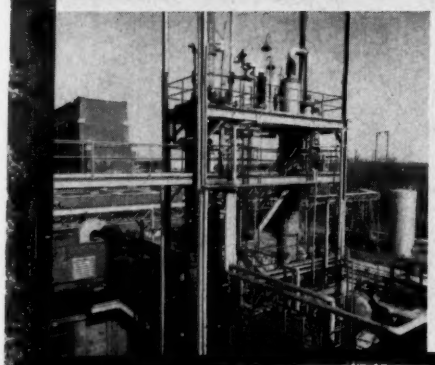

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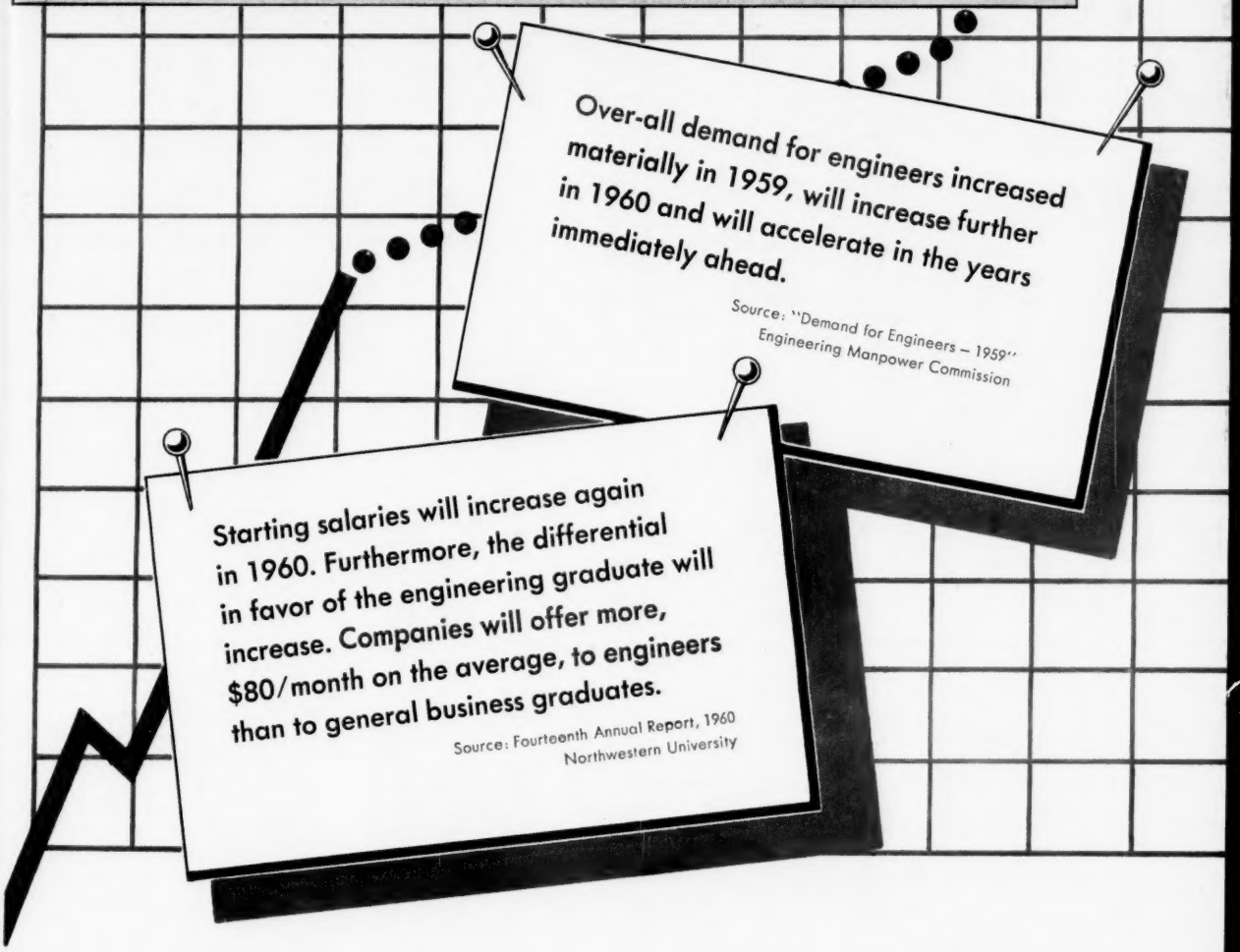

Over-all demand for engineers increased materially in 1959, will increase further in 1960 and will accelerate in the years immediately ahead.
Source: "Demand for Engineers – 1959" Engineering Manpower Commission
Starting salaries will increase again in 1960. Furthermore, the differential in favor of the engineering graduate will increase. Companies will offer more, $80/month on the average, to engineers than to general business graduates.
Source: Fourteenth Annual Report, 1960 Northwestern University

Demand Forces Salaries Up Again

Brace yourself for the barrage. The numbers game is about to begin again.

Two new surveys, just completed, state without equivocation that there is at the present time—and that there will continue to be—an unsatisfied demand for engineers. They are:

• "Demand for Engineers—1959," by Engineering Manpower Commission of Engineers Joint Council, 29 West 39th Street, New York 18 (Roy Wheelock, Executive Secretary).

• "Trends in the Employment of College and University Graduates in Business and Industry, 1960, Fourteenth Annual Report, A Survey of 211 Well-Known Business and Industrial Concerns," by Northwestern University, Evanston, Ill. (Frank S. Endicott, Director of Placement).

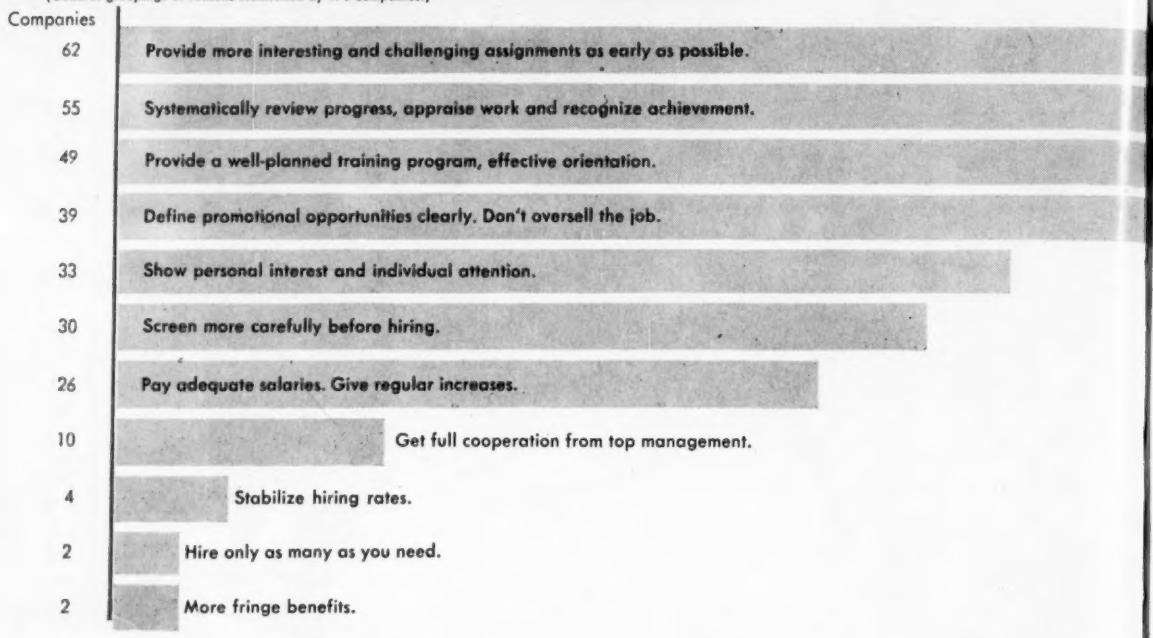
As soon as these two reports make the rounds, there's little doubt that you'll be subjected to a fresh onslaught of propaganda planned as another attack in the "shortage of engineers" theater of operations.

It would be poor strategy for you to enter the battleground of controversy again without some orientation concerning latest weapons and tactics. And that's our main reason for publishing this story. However, before we start to fill you in on the details, let's understand each other on one important point.

Some chemical engineers we have talked to are not yet convinced that these predictions

How to Reduce Engineering Turnover

(General groupings of reasons mentioned by 175 companies.)



are valid—that there is another shortage of engineers in the offing. Memories of late 1958 and early 1959 are still too fresh in their minds. Although the public relations departments of some of the largest chemical companies tried their best to minimize its significance, it is an undeniable fact that noticeable numbers of chemical engineers were routed out of their jobs by the recent recession.

Cancellation of the high-energy fuels program adversely affected employment in the Niagara Frontier area, for example, depressing salary offers to chemical engineers seeking re-employment some 10-15% below the going national rates.

But for two phenomenally successful exceptions, engineering and construction companies have, in general, been reluctant to hire new engineers or to replace engineers who have left them.

However, if the recession has really rebounded into a renewed shortage of engineers, that's good news for all chemical engineering employees (although it may be bad news for recruiters and managers of engineers). So let's examine the evidence.

▶ **Demand Up Materially**—Since 1951, Engineering Manpower Commission has conducted annual surveys (except for 1955) on demand for engineering graduates in industry.

The 1959 survey reports these conclusions:

- Industrial recruiting and over-all demand for engineers in 1959 increased materially over 1958. The net increase in the number of engineers employed by industry was more than double that in 1958 and would have been higher had sufficient supply been available.
- Demand for engineering graduates is expected to increase further in 1960 and will continue to accelerate in the years immediately ahead. Projected needs in 1966 will be 15 graduates for every 10 recruited in 1959, barring economic disaster and assuming stability in government expenditures.
- Starting salaries for 1959 B.S. engineering graduates reached a new high: $510/month median for all industries. Median for M.S. graduates was $600/month; and $825 for Ph.D.'s. Highest salaries were offered to those graduates who entered research and development programs, especially in the electronics and aviation fields.

Chemical employers ranked below the median with their starting salaries, which were: $500/month for the B.S.; $563 for the M.S.; and $745/month for holders of the Ph.D. degree.

▶ **Detailed Tabulations** — The EMC report includes detailed statistics in tabular form reporting the 1959 survey results and comparing them with previous surveys.

We've abstracted one of these tables for you. It shows the future demand and recruiting goals for new and experienced graduates expressed as percentage additions of engineers work-in industry in 1959.

Note especially that the EMC report is not restricted to new graduates alone. Employers furnished breakdowns of their intent to hire new graduates, as well as older engineers.

▶ **On the Supply Side**—In 1959, 38,162 B.S. degrees were awarded in engineering. This is the largest class since 1951. Since 1955-1956 the number of engineering graduates being called for active military duty has decreased substantially and the number returning from military duty (from inductions of earlier years) has increased.

Therefore, the supply of graduate engineers available for immediate employment has risen

sharply. According to EMC, we have observed in 1959 a resurgence in demand for engineering graduates from a decline in 1958; to a large extent the increased needs are being met by increased supply of graduates but deficiencies are growing in many specialty and industry areas.

One dark cloud hovering over the supply situation is the decline for the second year in a row of freshmen in engineering schools. Enrollment for the fall 1958 entering class was 11% below 1957; enrollment in the fall 1959 freshman class was down another 3% below 1958.

Add to this the fact that older engineers are sticking longer on their present jobs. EMC reports that engineering turnover in 1958 averaged 9.5%, a decline from 1957's 11%; and was expected to drop to 8.6% in 1959 final figures.

▶**News From Northwestern**—Many of you are already familiar with the Endicott reports issued for the past 14 years by Northwestern University. They have received nationwide publicity.

Of course, this particular report is restricted to employment trends for new graduates only. However, recruiting on college campuses is an indication of employment conditions in general.

Endicott predicts that the employment opportunities for inexperienced engineering graduates will be 19% greater in 1960 than they were in 1959. Other predictions are:

• Starting salaries will increase again, continuing the upward trend which has been apparent for many years. Furthermore, the differential in favor of the engineering graduate over the graduate in general business will increase. It appears that companies will offer at least $80/month more, on the average, to the engineers. Five years ago, in 1955, this differential was only about $32.

• Probably the 1960 average for engineering graduates will be about $515/month. In 1959 the figure averaged slightly under $500/month. (Please note that Northwestern cites averages while EMC gives median figures.)

• Of special interest in the present survey are data regarding the loss of graduates during the first few years of employment and the reasons why these men left their employers. The bar chart above, summarizes the suggestions made by employers on effective ways to reduce this turnover.

▶**Restless Youth** — Endicott asked the responding companies to indicate what percent of the beginning college men hired from recent classes were still employed in the company, excluding those who left to enter military service.

Of the class of 1958, 88% are still employed; class of 1956, 66% still employed; class of class of 1954, 64% still employed.

Most common reasons for leaving jobs were: wanted different kind of work; got better salary; preferred to live elsewhere; left at the employer's suggestion; wanted more responsibility or more challenge.

▶**Offers Accepted**—How many offers did an employer have to make to actually add a new graduate to his payroll?

Engineers were the hardest to attract. 114 companies told Endicott that they had to make 2.3 offers to hire each engineering graduate actually recruited in 1959. In other fields, only 1.7 offers were necessary.

We recommend that you obtain or borrow copies of these two reports, read them and decide for yourself. And we'll be mighty interested in hearing your opinion on the subject.

Industry's Future Demand for Engineers

(Additions given as percentage of engineers employed in 1959.)

Industry	1959 New Grads	1959 Old Grads	1959 Total	1960 New Grads	1960 Old Grads	1960 Total	1963 New Grads	1963 Old Grads	1963 Total	1966 New Grads	1966 Old Grads	1966 Total
Petroleum	4.6	1.0	5.6	6.1	0.8	6.9	7.4	0.9	8.3	8.3	1.1	9.4
Chemicals	2.5	1.9	4.4	7.4	1.8	9.2	7.3	1.6	8.9	8.6	2.2	10.8
Rubber	11.8	1.6	13.4	10.0	1.7	11.7	12.5	5.0	17.5	15.0	7.5	22.5
Primary metals	5.3	1.8	7.1	4.6	3.6	8.2	5.5	4.1	9.5	6.1	4.9	11.0
Electrical machinery	6.2	12.3	18.5	7.4	9.5	16.9	9.2	13.5	22.7	11.4	16.4	27.8
Aircraft	6.5	13.2	19.7	5.2	17.0	22.2	7.3	16.0	23.2	8.4	19.6	28.0
Telecommunications	9.1	14.0	23.1	14.1	10.0	24.1	16.5	11.0	27.5	18.5	11.0	29.5
Consulting	3.5	8.4	11.9	4.5	12.0	16.5	5.5	10.1	15.6	7.1	12.0	19.1
Research & development	9.6	6.7	16.3	10.0	15.6	25.6	16.5	17.5	34.0	20.4	26.6	47.0
Average of all	5.6	7.8	13.4	7.0	8.2	15.2	8.3	8.8	17.1	9.8	10.8	20.6

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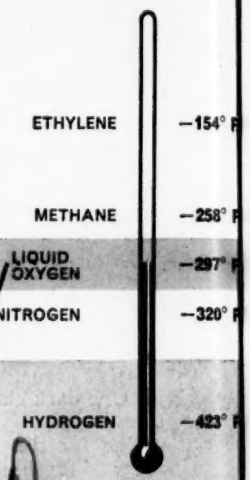

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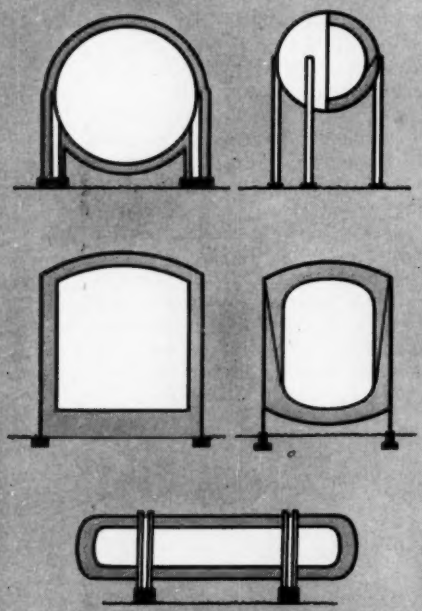

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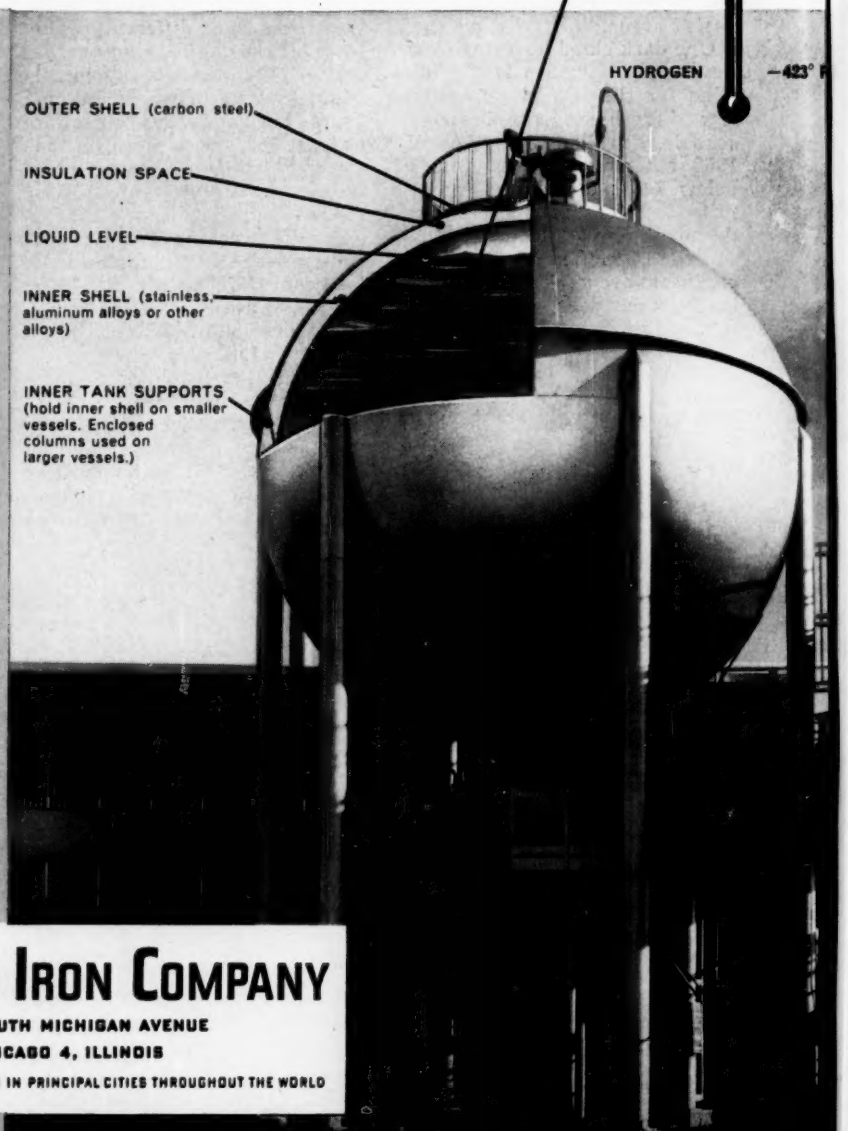
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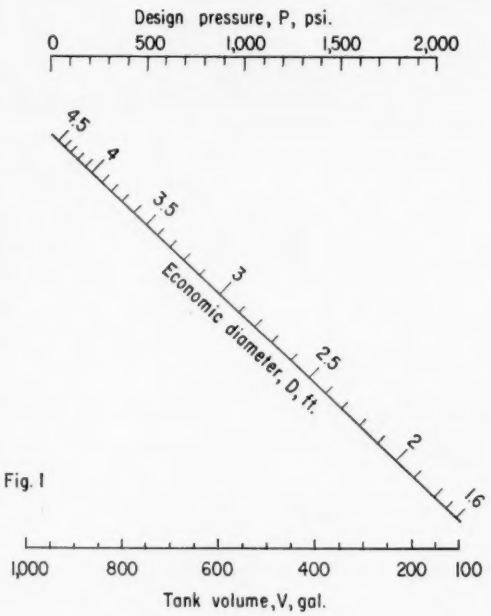


Fig. 1

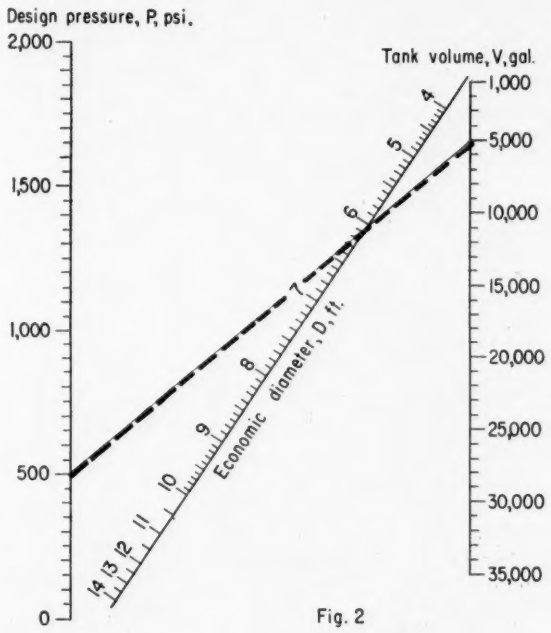


Fig. 2

Nomographs Help Find Tank Diameter

New charts take design pressure into account when determining most economic diameter for vessels up to 35,000 gal. in capacity.

Leon Green
Dept. of Nuclear Engineering, Brookhaven National Laboratory, Upton, L. I.

The most economic diameter for a pressure vessel is one which keeps the weight of the vessel to a minimum.[1] There may be other considerations governing the design of the vessel, such as plant layout, symmetry and foundation requirements.[2] But you will find economic diameter a useful tool for preliminary estimates of vessel costs before a plant layout is made or when vessel size is not restricted by location.

The nomographs, Fig. 1 for 100 to 1,000-gal. vessels and Fig. 2 for 1,000 to 35,000-gal. vessels, give solutions to the equation:

$$D^4 + \frac{0.083D^3}{K} - \frac{0.00905V}{K} = 0 \quad (1)$$

where D is the vessel diameter, V is the volume in gallons, K is $P/(2S\text{-}P)$ in which P is the design pressure and S is the design stress.

Eq. (1) is the derivative of the weight equation for a cylindrical vessel with 2:1 ellipsoidal heads. We have generalized the original equation for any design pressure as follows:

$$W = 2.45KwD^3 + 0.306D^2 + 0.0664V/D + 3.99Kw \quad (2)$$

where W is the vessel weight and w is the unit weight of the vessel shell.

We have assumed the design stress as 11,700 psi. and allowed

⅛ in. for corrosion. We also increased the terms involving the heads by 50% to allow for the higher cost of the heads over the shell. Design stress is based on ASTM A-70 firebox steel, which has an ultimate tensile strength of 55,000 psi. and a safety factor of 4. We also assumed a weld efficiency of 85%.

These nomographs are easy to use. Simply draw a straight line between the desired pressure and volume and read off the economic diameter from the slanted line. For example the economic diameter for a 5,000 gal. vessel with a 500 psi. design pressure would be 6 ft., as shown in Fig. 2. Or, from Fig. 1, for a vessel with a volume of 600 gal. and a 1,000 psi. design pressure, the economic diameter is 2.94 ft.

To find the length of the vessel, you may use the following approximate equation:

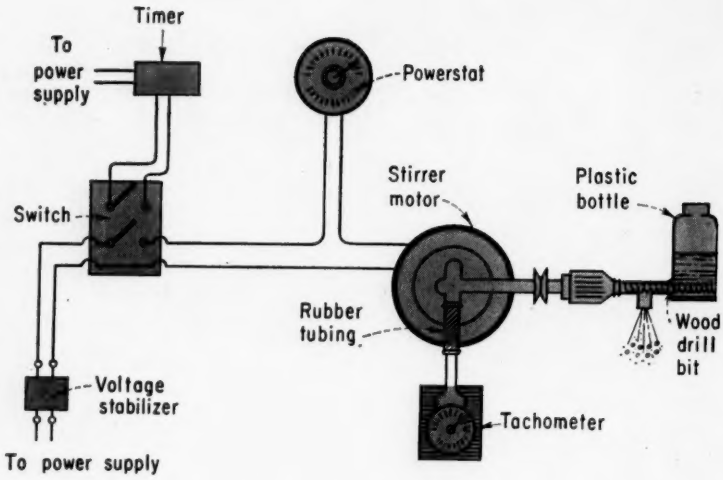
$$L = \frac{4V}{7.48\,D^2} - \frac{D}{3} \qquad (3)$$

Or you can use the chart published in *Chemical Engineering*[3] for finding both length and surface area of the vessel.

The length of the vessel in our first example above, as calculated from Eq. (3), is 21 ft.

REFERENCES

1. Happel, J. "Chemical Process Economics," John Wiley & Sons, Inc., N. Y. (1958).
2. Brummerstedt, E. F., *National Petroleum News* 36, May 3, 1944; June 7, 1944.
3. Resnick, W., *Chem. Eng.*, Aug. 24, 1959, p. 144.



Timed Bench-Sized Screw Feeder

Carlos A. Zapata
Chemical Engineer, Ansul Chemical Co., Marinette, Wis.

Here is a handy refinement of an item that appeared in the Jan. 12, 1959; issue of *Chemical Engineering*.[1]

We were confronted with the problem of feeding dry solids and fine chemical powders at low and accurate rates to a reaction system. Three years ago we developed the device shown above, using standard carpenter's wood drills as screw feeders. The rest of our equipment is also fairly standard and should be available in any laboratory.

The device was made of a 1/50 hp. stirrer motor equipped with a chuck to take shafts to ⅜ in., a tachometer graduated in rpm., a variable transformer, an electric timer graduated to 1/100 sec., and a 4-oz. plastic bottle to which was attached by heat softening a plastic tee that enclosed the wood drill and served as the discharge nozzle.

You could use copper tubing in place of the plastic tee.

We arranged the equipment as shown in the sketch above, attaching the tachometer to the low speed power shaft of the stirrer motor with a piece of rubber tubing serving as a coupling.

You can easily remove the plastic bottle from the drill bit for weighing. Calibration is simple, just weigh the discharge over a period of time for a particular drill bit. Rate of discharge can be varied by controlling the speed and changing the drill size.

REFERENCE

1. Simpson, R. H., and M. Serrano, *Chem. Eng.*, Jan. 12, 1959, p. 139.

NEXT ISSUE: Watch for January Contest Winner

★ How Readers Can Win

$50 Prize for a Good Idea—Until further notice the Editors of *Chemical Engineering* will award $50 each four weeks to the author of the best short article received during that period and accepted for Plant or Process Design Notebook.

Each period's winner will be announced in the second following issue and published in the third or fourth following issue.

$100 Annual Prize—At the end of each year the period winners will be rejudged and the year's best awarded an additional $100 prize.

How to Enter Contest—Any reader (except a McGraw-Hill employee) may submit as many contest entries as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Acceptable nonwinning articles will be published at space rates ($10 minimum).

Articles should interest chemical engineers in development, design or production. They may deal with useful methods, data, calculations. Address Plant & Process Design Notebooks, *Chemical Engineering*, 330 W. 42 St., New York 36, N. Y.

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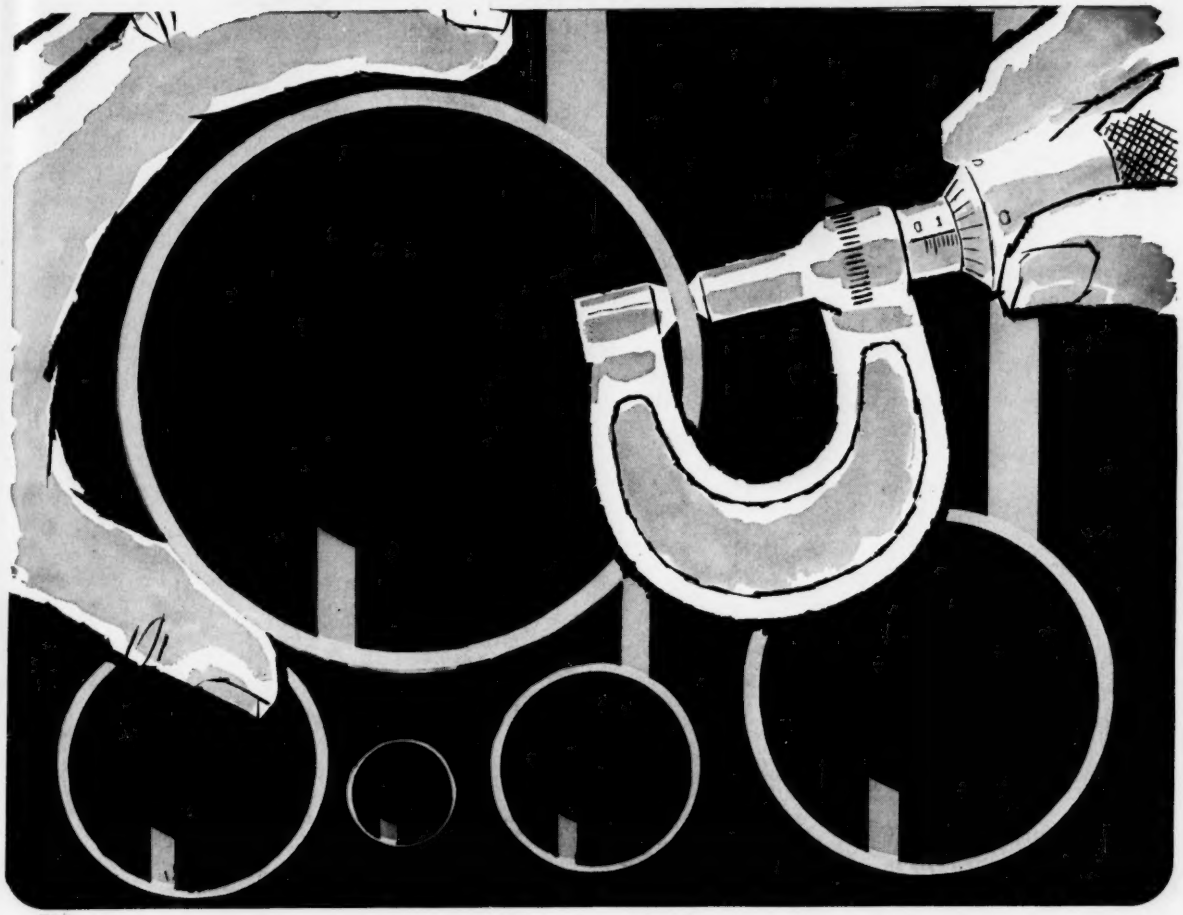

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CE COST FILE

No. 24: Construction Equipment Rental Rates

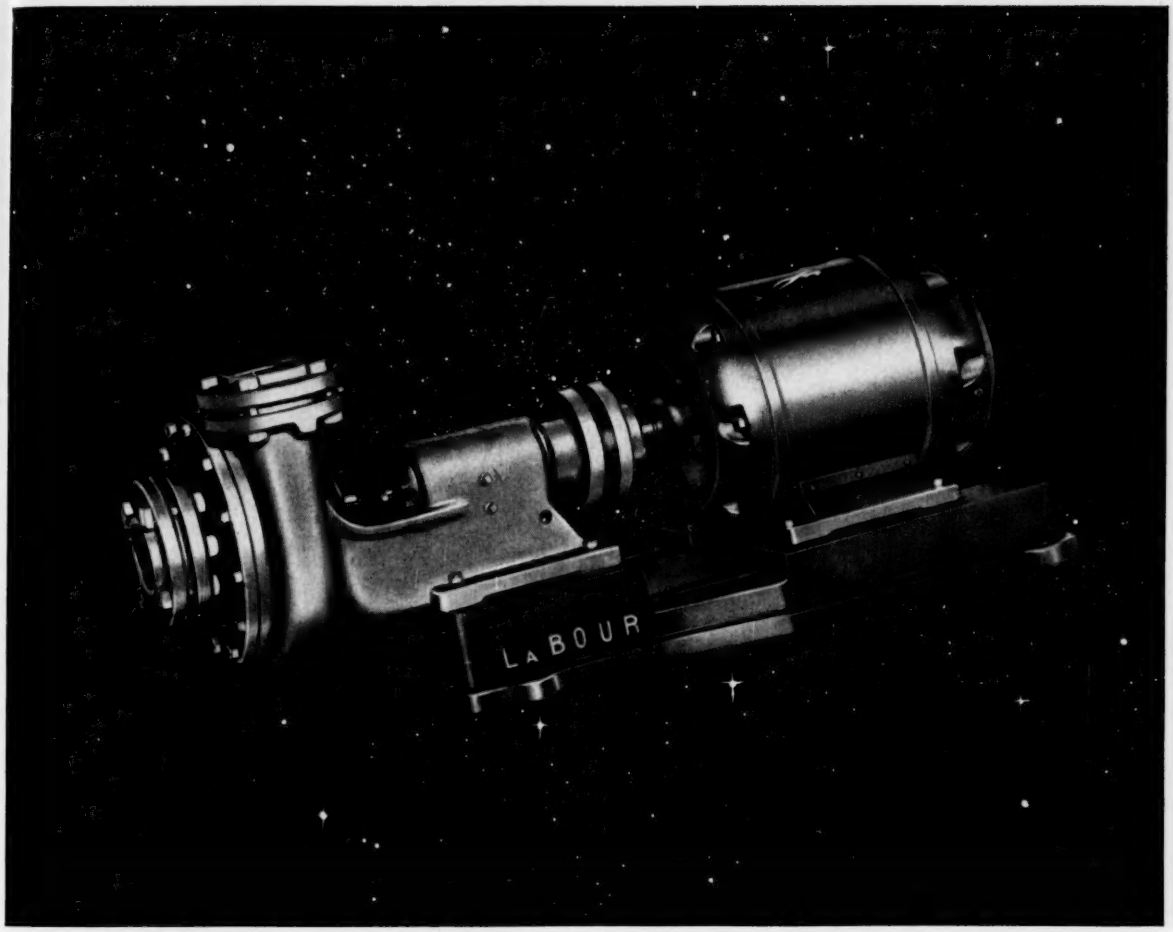
Charles A. Adams, Texas Butadiene & Chemical Corp., Channelview, Texas

Sometimes it's convenient to rent rather than buy equipment for a plant construction project. A source of information for rental rates of construction equipment is the blue, or green, book prepared—on the basis of national averages—by Associated Equipment Distributors, Chicago, Ill.

The following information, updated to June 1959 from the blue book, is bare rental costs for some commonly required equipment. Rental rates do not include insurance, taxes or license. They are computed on straight-time basis. All rates are F.O.B. lessor's shipping point.

	M & O* $/hr.	Bare Rental Monthly	Weekly	Daily
WINCH TRUCKS				
2 ton, Ford	$7.50	$425.00	$145.00	$42.50
3 ton, Mack, Chevrolet	7.50	425.00	145.00	42.50
5 ton, Mack	8.00	525.00	175.00	55.00
TRUCKS: PICKUP, FLAT-BED, DUMP				
½ ton, pickup	4.75	200.00	70.00	20.00
¾ ton, pickup	4.75	200.00	70.00	20.00
3 ton, flatbed	6.00	400.00	175.00	55.00
3 ton, flatbed, dumps	6.00	400.00	175.00	55.00
5 ton, flatbed	6.00	400.00	175.00	55.00
5 yd., dump	6.00	375.00	125.00	40.00
12 yd., dump, tandem	12.50	800.00	298.00	90.00
MISCELLANEOUS VEHICLES				
Ford tractor	8.00	236.00	86.00	27.00
International tractor	8.00	369.00	122.00	40.75
Fork lift, 4,000-lb. capacity, pneumatic tires		367.00	114.00	26.00
Fork lift, 6,000-lb. capacity, cushion tires		380.00	118.00	30.00
Fork lift, 4,000-lb. capacity, cushion tires		346.00	101.00	25.00
WELDING MACHINES				
200 amp., gas		100.00	34.00	10.50
300 amp., gas		129.00	43.25	13.75
400 amp., gas		150.00	53.75	21.00
200 amp., electric		50.00	17.75	5.70
300 amp., electric		63.75	22.75	6.90
400 amp., electric		71.50	27.50	7.60
Welding cable		0.15/ft./month		
COMPRESSORS				
25 cu. ft./min., gas		$92.25	$31.00	$8.90
75 cu. ft./min., gas		145.00	48.00	15.00
125 cu. ft./min., gas		209.00	70.00	21.25
210 cu. ft./min., gas		336.00	110.00	33.50
210 cu. ft./min., diesel		415.00	137.00	44.00
315 cu. ft./min., elec		335.00	111.65	28.00
315 cu. ft./min., diesel		545.00	179.00	57.75
500 cu. ft./min., diesel		748.00	247.00	79.75
600 cu. ft./min., diesel		928.00	310.00	101.00
Air hose, ¾ in. (50 ft.)		9.15	3.90	1.65
MOTOR CRANES				
35 ton, Lima 54-T, 30-B	$32.50	3,917.00	1,353.00	451.00
30 ton, HC-98	27.50	2,951.00	1,023.00	340.00
25 ton, HC-90	25.00	2,319.00	806.00	261.00
Austin-Western hydraulic	14.50	1,300.00	459.00	151.00
CRAWLER CRANES (without bucket)				
3 yd., Manitowoc 3900	55.00	5,760.00	1,873.00	627.00
2½ yd., Manitowoc 3500-54-B	40.00	4,501.00	1,540.00	514.00
2 yd., Manitowoc 3000	30.00	3,464.00	1,164.00	401.00
1½ yd., NW-6, 38-B	24.50	2,628.00	888.00	299.00
1 yd., Lima 44	17.50	1,876.00	625.00	209.00
¾ yd., 22-B	15.00	1,531.00	508.00	168.00
⅜ yd., Bantam backhoe	15.00	997.00	324.00	107.00
⅜ yd., T9 internat'l Harvester Cherry Picker	10.50	650.00	200.00	65.00
CRAWLER TRACTORS				
D-6 Caterpillar dozer, with winch	16.50	1,546.50	522.25	169.00
without winch	15.00	1,343.50	455.25	147.50
D-7 Caterpillar sideboom	17.50	1,427.00	479.00	152.75
D-7 Caterpillar dozer	17.50	1,810.00	600.50	193.75
D-8 Caterpillar dozer, w/torque converter	23.50	2,601.00	855.25	274.25
w/o torque converter	20.00	2,601.00	855.25	274.25
Oliver tractor	9.50	598.50	206.00	64.75
FRONT-END LOADERS				
Allis Chalmers, HD-5	12.50	870.00	292.00	85.75
Allis Chalmers, HD-6	13.50	1,033.00	342.00	108.00
Internat'l Drott, 4-way bucket	13.50	1,033.00	342.00	108.00
Caterpillar, #955 Traxcavator	13.50	1,033.00	342.00	108.00
Fordson, backhoe and front-end loader	12.50	704.00	255.00	94.25
DIRT MOVING AND COMPACTION EQUIPMENT				
DW-15 Caterpillar scrapers	$20.00	$2,844.00	$965.00	$327.00
Model 12 Caterpillar Motor Patrol	15.00	1,290.00	426.00	138.00
12 yd. Caterpillar, tractor-drawn scraper		607.00	197.00	63.00
Gradall, tire mounted, diesel, complete	17.50	2,063.75	641.75	187.55
Gradall, crawler, diesel, complete	17.50	1,996.75	646.75	188.55
Cleveland, #110 ditching machine	16.50	989.00	341.00	111.00
42-in. double-drum sheepsfoot roller		234.00	59.00	19.25
Wobble-wheel roller, 13 wheels		186.00	63.00	19.50
Wobble-wheel roller, 9 wheels		166.00	56.75	17.75
Essick vibrating roller, VR-54-T		450.00	150.00	37.50
Tandem discs		137.00	45.00	11.00
FLOATS & LOWBOYS				
20-ton self-loading floats	13.00	800.00	250.00	65.00
30-ton self-loading floats, tandem	15.00	1,000.00	350.00	85.00
30-ton lowboy	15.00	1,000.00	350.00	85.00
60-ton lowboy	25.00	1,200.00	400.00	100.00
Pole trailer	17.50	800.00	200.00	40.00
BUCKETS				
⅝ cu. yd. clamshell		129.00	42.75	14.50
¾ cu. yd. clamshell		143.00	47.75	16.50
2 cu. yd. clamshell		279.00	89.75	29.75
⅜ cu. yd. dragline		69.50	23.75	7.85
½ cu. yd. dragline		84.00	28.25	9.50
1 cu. yd. dragline		127.00	43.00	14.50
1¼ cu. yd. dragline		153.00	51.00	16.75
1½ cu. yd. dragline		167.00	56.25	18.75
2 cu. yd. dragline		212.00	72.25	24.00
2½ cu. yd. dragline		256.00	85.00	27.75
1 cu. yd. bottom dump, concrete		63.00	22.25	8.25
½ cu. yd. laydown, concrete		48.50	18.00	6.95
1 cu. yd. laydown, concrete		71.50	25.00	9.05
1½ cu. yd. laydown, concrete		102.00	33.25	12.50

* Maintenance and operation; straight-time basis



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Don't Accept Specification Headaches

Don't put up with ill-defined specifications. Re-evaluate them in light of what's really needed.

WINGATE H. RICHARDSON, Consultant, New York, N. Y.

Anyone who engages in production operations for a period of time, sooner or later, runs into trouble with specifications. Generally, both your raw materials and products are covered by specifications and you can encounter trouble with either.

When raw materials fail to meet specifications, responsibility falls on the supplier. This sounds deceptively simple. Sometimes it's extremely difficult to establish the facts:

- Is the sample properly representative of the shipment?
- Are your testing procedures adequate?
- Are you sure nothing happened to the shipment after you received it?

A rhubarb can develop over the interpretation of almost any paragraph of a specification.

In spite of all this, principal headache for the production man occurs with specifications covering his own product. A complaint may come directly from the customer, or from your own control laboratory, or the sales department. In any event, it's up to you to do something about it.

▶ **Only Necessary Information**—In simplest terms, a specification is a precise description of the material; that is, it should contain a clear and complete description of all properties necessary for the satisfactory use of the material—nothing else.

This last is often overlooked.

Data which a specification is based on, are commonly supplied by the development laboratory, research laboratory or sometimes by the sales department. Specifications are usually written on the assumption the best is none too good. But the best may be much too expensive.

So . . . let's leaf back through the old log book.

▶ **A Smooth Startup**—At the beginning of the war, demand for one of our fine chemicals increased enormously and it became necessary to erect a separate facility for its production on a heavy chemical basis.

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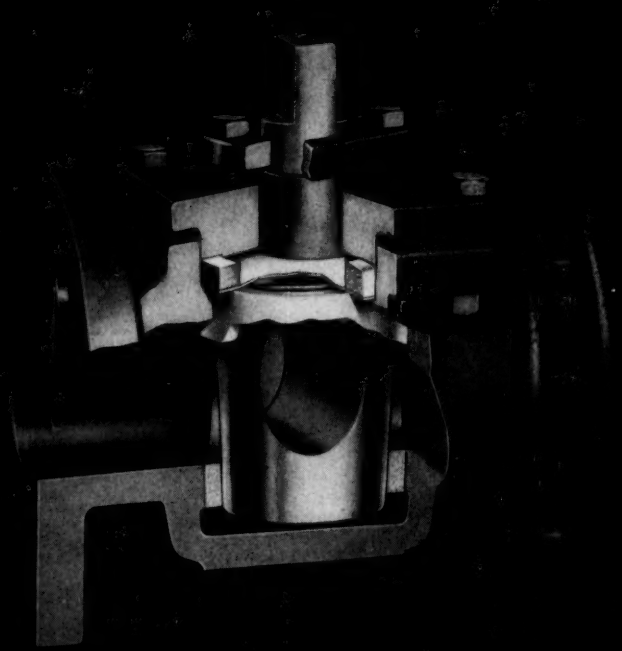

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gave us some trouble at first but in a short time our crystallizers settled down to proper operation and we started shipping on schedule.

One by one, various minor difficulties of operation were ironed out and life became comfortable and serene.

▶**But Troubles Came In**—Then I got a call from our inspection department:

"Your Lot No. 185 failed to meet specifications and you'll have to rerun this material."

Well, a lot was 100,000 lb., and I was in no mood to redissolve and recrystallize this material without some pretty good evidence that such a task was necessary.

"What's wrong with it?" I said.

"Specifications call for less than 1% on the 35 mesh screen and this lot fails to meet that requirement."

"How much was on the 35 mesh screen?" I asked.

"Well, it's exactly 1%," he answered.

"I guess I better come over and look at your test results."

I went over to talk to the chemist that ran the tests on this particular lot. He was quite cooperative and readily produced his record book so I could see the original figures. Suddenly I noticed his calculations for the 35 mesh screen: 0.6%.

▶**What's In a Number?**—"Wait a minute. You said this sample contained 1% on the 35 mesh screen and here you show 0.6%. How come?"

"Well that's all right," he answered. "Specifications say to report the screen analysis to the nearest 1%. So a figure of 0.6% is reported as 1%."

"Do you mean to tell me your analysis showed 0.6% and you reported this as 1% and then rejected the lot because the amount remaining on the 35 mesh screen wasn't less than 1%?"

"That's right. That's the procedure required by the specifications." And he produced the specifications to prove his point.

Well, I went to the head of the inspection department and reviewed these facts with him. He was fully aware of all the facts.

"Do you mean to tell me you rejected this lot on that basis?"

"As a matter of fact we haven't rejected it," the chief inspector said. "I just called you on an unofficial basis to let you know that this lot won't pass specifications. I thought you would want to run it over to avoid having it on the record that you produced a bad lot."

"I'm not going to rerun it. I'm going to certify it for shipment. If you want to stop the shipment you'll have to reject it officially."

After I returned to my office, he called to say they wouldn't reject it officially, but that he made a memorandum of our conversation and if the material was rejected by the Army, it would be my responsibility. This was all right with me.

▶**Not the Right Specs**—A few days later I ran into the Captain in charge of the Army laboratory. I guess my conscience was bothering me a bit so I started to tell him how I had run a fast one through his laboratory. Before I had much more than started, he stopped me.

"Are you talking about that lot with 1% on the 35 mesh screen? We don't care about that. We wouldn't reject it if it had 10% on the 35 mesh screen. The important thing to us is moisture content.

"In subsequent processing of this material, moisture removal is necessary and quite expensive. Reduction of moisture by even 0.1% would save us thousands of dollars a day."

Maximum moisture allowed by specifications was 1.0% and so easily met that we normally shipped 0.5 to 0.6% and could easily have reduced this to 0.2 to 0.3%—had anyone bothered to tell us of its importance.

▶**Dirt in the Process?**—There is one other case of a rejected lot that may interest you. I was notified a certain lot number was rejected because of dirt in the product.

This lot was stored in drums in the process building, pending approval for shipment. I went up and located the lot. Selecting a few drums at random, I removed the covers and looked at the material. It was as clean and white as new fallen snow.

Then, I went to the laboratory to look at their sample. It was

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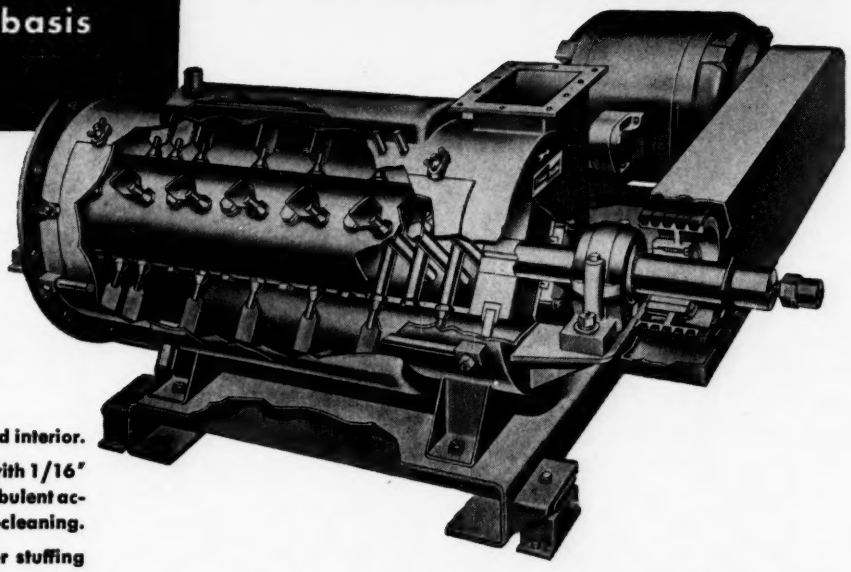

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definitely dirty. So it appeared I hadn't looked at the same drums as selected for sampling. I got the numbers of the drums that had been sampled.

But, it struck me, why would only certain drums contain dirty material? Had the covers been left off long enough during the sampling to allow fly ash from the nearby boilers to get into the drums?

I talked to the man who took the samples and was assured this didn't happen. He was cautioned about fly ash and had taken his sample from only one drum at a time being careful to replace each cover immediately after taking the sample.

"What did you collect your sample in?"

"An enameled dishpan."

"What kind of cover does it have?"

"Oh, there isn't any cover on that."

I suggested he get a cover for the dishpan.

▶**Some Are Too Detailed**—Sometimes, specifications are absurdly complex and detailed. Some government specifications give the raw materials, the process in detail for the conversion, the properties of the finished material and I wouldn't be surprised to find one that specified the hardness of the lead in the pencil used to calculate the results of the analysis.

Some specifications are absurdly simple. But these can be troublesome too.

▶**A Simple Odor Test?**—One customer had a rule that his receiving department couldn't accept delivery of one of our products without the chief chemist's approval.

When our trucks arrived at the plant, the receiving clerk called the chief chemist out to the receiving platform. He removed the bung from the drum, put his nose as close to the opening as possible and after a few sniffs announced his decision. "All right accept it," or "It's no good, send it back."

Our truck drivers were both amused and annoyed. They considered him strictly a screwball. Our own laboratory people were inclined to share this opinion since they were never able to distinguish any difference between the material he accepted and the material he rejected. And, our chemists were also skilled in the techniques of testing by odor.

▶**Checking the Checker**—One day we decided to test his analytical procedures for reliability. Our truck had returned with a rejected drum. We decided to set this drum aside for delivery to the same customer when he again ordered. In the meantime, of course, we delivered an acceptable drum.

Well, on the next order the drum was repainted, a new lot number stenciled on and delivered. It was rejected.

This test run was made with other drums from time to time. He never missed. Our truck drivers removed him from the screwball list. We all agreed that he knew what he was doing when he made his "analysis."

In this day and age, when we all tend to worship at the altar of science, we sometimes forget the importance of the "practice of the art."

▶**Who Wrote Those Specs?**—I guess this should be told in the classical manner. "Once upon a time," a rhubarb developed between a production division and another group within the same company using their product.

During the course of many a heated debate, and after much correspondence, a sort of begrudging friendship developed between the antagonists and they agreed to find a third party to lay the blame on. This third party they selected turned out to be the division responsible for the design of the troublesome process.

Head of this division immediately assigned the task of defense to a new (and expendable) man on his staff, with brief instructions:

"Don't let them do this to us."

Our hero took off for the scene of the action, the production plant, to make inquiry and take observation.

This process was a relatively simple one of impregnating protective clothing. Equipment consisted of an arrangement of tumblers and dryers of the type in common use in the laundry business.

Question: How do you test the finished garment?

Answer: We use a steel die to cut a circle, with a 4-in. area, out of the garment. We select a garment and cut two circles out of the front where the cloth is single thickness, two at the edge where the cloth is double, two under the arms where four seams meet and three out of the back.

These 4-sq.-in. samples are then placed in a beaker and the impregnating material leached out and assayed. Results are calculated as gm. of material/sq. in. of cloth.

Question: How do you take the sample?

Answer: We take every third garment.

Question: Do you mean to say that ⅔ of your total output is consumed in your test procedure?

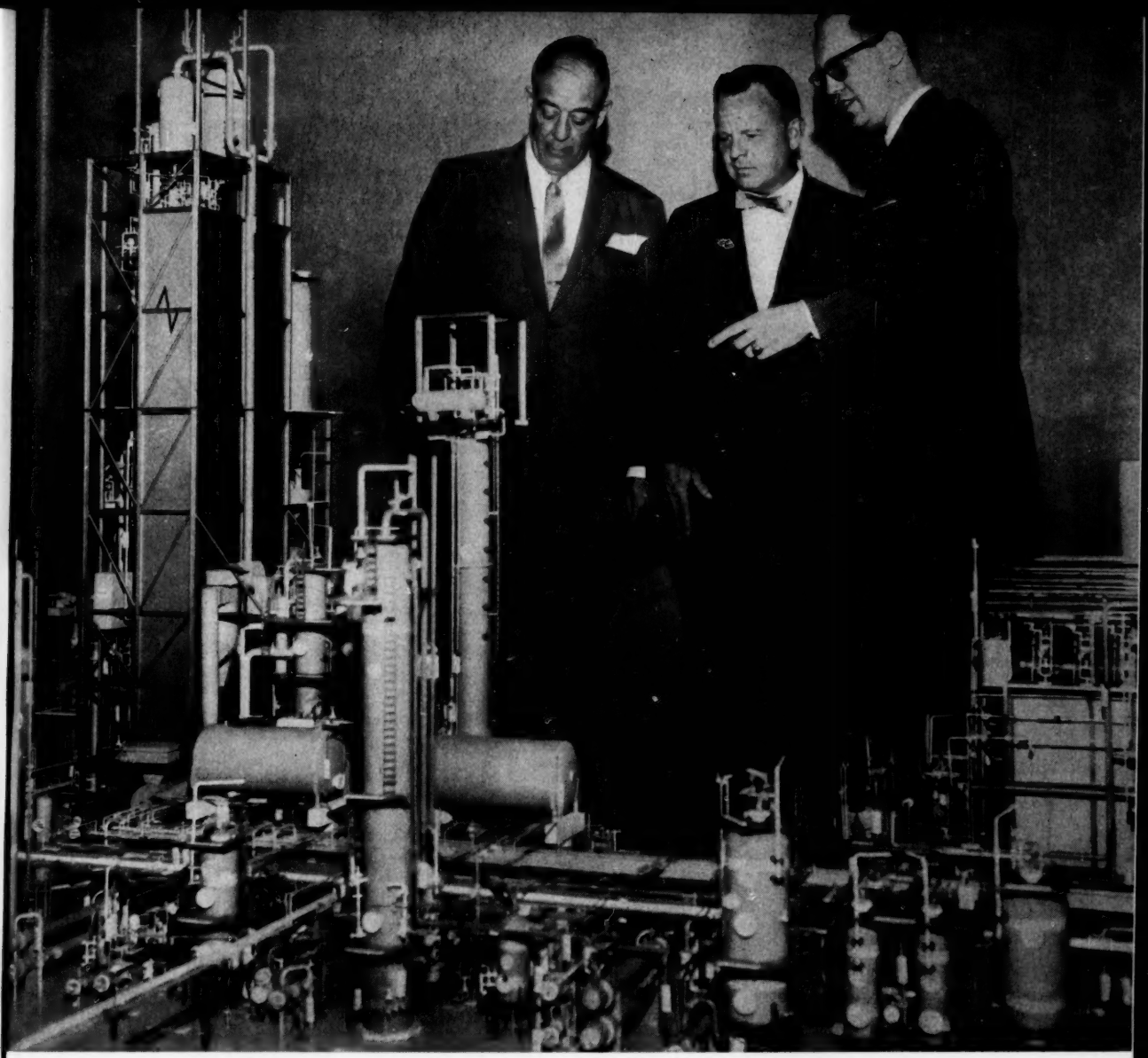
Answer: We didn't write the specifications.

▶**A Spec Is a Spec Is a Spec**—Source of this sampling procedure was ultimately traced to a department of statisticians who are unquestionably experts at this sort of thing. Our hero was assured that careful calculations had been made to determine the number of samples necessary to give proper reliability to the laboratory results. Pages of calculations were brought out for his inspection. He didn't question the figures. He felt he wasn't sufficiently acquainted with them to say "hello" let alone question them. Anyway, he was a little numb by this time.

Final solution to the trouble? This plant was using some old impregnating material that wouldn't disperse properly and thus wasn't applied uniformly to the garments.

But, our hero tells me that as far as he knows, ⅔ of the total output of the plant still moves inexorably into the analytical laboratories to vouch for the character of the ⅓ that escape to useful activity.

Yes, specifications can sometimes make a production man mighty unhappy. But there's always the positive, cheerful approach, to wit: If you are a production man, you aren't supposed to be happy anyway.



SEEING IS SAVING...

One important advantage of plant models is that managements can fully exercise their judgment and experience in approving design and layout *before* construction starts.

Here, SunOlin Chemical Company vice-president S. S. Johnson and president James I. Harper are shown reviewing, with Kellogg project manager Robert Jacks, details of their new 200 ton/day urea plant—now being built by Kellogg, using the Fauser-Montecatini Process.

For SunOlin, as for many Kellogg clients, scale models have proved to be an unequalled communications tool for management . . . a superior design tool for engineers . . . a modern construction tool for field workers . . . a sure way, in every way, to minimize man-hours and materials.

Kellogg-built models have obviated planning stages and piping key plans . . . eliminated hundreds of complex drawings . . . avoided countless hours for reviewing, changing, and interpreting design and construction details on paper . . . saved Kellogg clients real time and money from plant conception to completion.

For the complete story of Kellogg's coordinated engineering, procurement, and construction services, ask for brochure, "Planning the New Plant for Profits".

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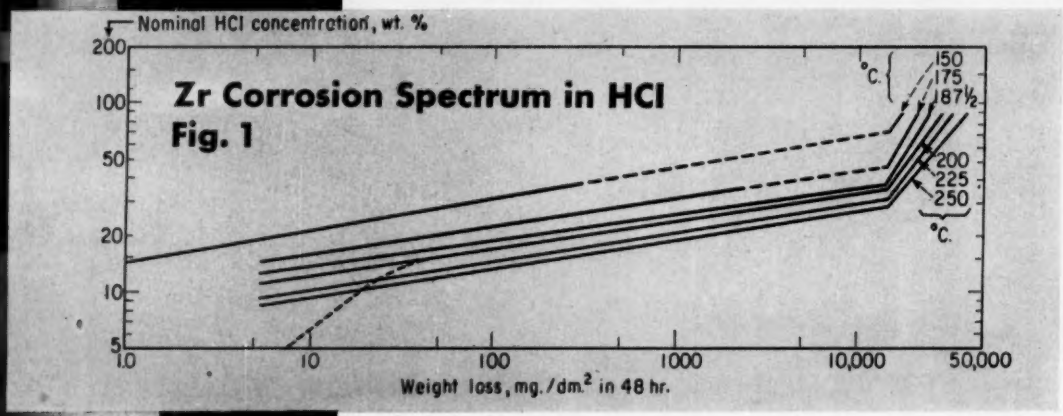

Zr Corrosion Spectrum in HCl
Fig. 1

Higher Purity Boosts Zirconium Resistance

Recently improved metallurgical techniques yield commercial-grade zirconium with low impurities. Corrosion resistance is superior to "impure" metal.

W. E. Kuhn, The Carborundum Co., Niagara Falls, N. Y.

Today, there are just a small number of in-service chemical-process applications of zirconium equipment. And understandably so, considering that the metal is only recently available in fabricable forms.

Nevertheless, there are many applications where commercial-grade zirconium should prove to be the best choice, even though it is a relatively expensive material on a first-cost basis.

Of particular importance is recently developed information confirming the outstanding corrosion resistance of commercial-grade zirconium produced by newly developed production processes.

The extensive studies of Golden, et al.,[1-4] first revealed the diversified corrosion resistance of zirconium, although the metal had been induction melted and contained carbon as an impurity. When carbon content is greater than about 0.08 wt. %,

◀ **ZIRCONIUM BURNER assembly for sulfur solves catalyst poisoning problem in sulfuric production—Zr pickup is very low.**

Metal chlorides causing corrosion?

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What effect do contaminants, temperature, flow rates, and concentration have on this resistance? Why not find out for sure by testing HAYNES alloys under your own process conditions? We'll gladly send you samples. To help us select the alloy most likely to solve your problem, we suggest that you send us a letter outlining the corrosive conditions in your plant. To learn more about HASTELLOY alloys, ask for a copy of our 104-page book.

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How Four Zirconium Grades Compare in Corrosion Resistance—Table I

Grades of Zirconium	Diamond Pyramid Hardness (5 Kg. Load)	Corrosion Rate (Mils/Yr.) Boiling 20% HCl for 1,008 Hr.	Corrosion Rate (Mils/Yr.) 20% HCl 200 C. for 144 Hr.
1. **Iodide Zirconium.** Annealed zirconium sheet, equiaxed grain structure. Minimum Zr + Hf 99.83%.	84	<0.02	8 (no intergranular attack)
2. **Reactor-Grade Magnesium-Reduced Zirconium.** Minimum Zr + Hf 99.86%. Vacuum arc-melted ingot. Hot rolled 1600 to 1500 F. to 3/16 in. strip, annealed at 1550 F., cooled in still air.	125	<0.05	30 (no intergranular attack)
3. **Commercial-Grade Magnesium-Reduced Zirconium.** Minimum Zr + Hf 99.76%. Hot rolled strip prepared from a vacuum melted ingot. Equiaxed grain structure, average grain size 0.003 in.	151	<0.1	30.1 (no intergranular attack)
4. **Commercial-Grade Magnesium-Reduced Zirconium.** Minimum Zr + Hf 99.68%. Hot rolled strip prepared from an argon melted ingot. Equiaxed grain structure, average grain size 0.0008 in.	158	<4.5	55 (intergranular attack)

carbides form in the metal matrix and reduce corrosion resistance in some media, particularly hydrochloric acid. Now that induction melting of zirconium has been superseded by consumable-electrode vacuum melting[6] in arc furnaces (cold crucible), it is desirable that corrosion data for the metal, representative of recent metallurgical practice, be made available to process and design chemical engineers.

▶ **HCl Data**—At least 15 different types of materials are used in hydrochloric-acid service. Nonmetals include glass, rubber, plastics, carbon and graphite. In fabricated form they are invariably less expensive than metals, and in a few instances operate in hydrochloric acid at temperatures which exceed that possible with metals, with the exception of pure zirconium and tantalum. The main disadvantages of nonmetals are relatively poor mechanical properties and low thermal conductivity.

Metals include stainless steel, tantalum and alloy metals marketed under such well-known names as Hastelloy, Chlorimet and Durichlor. With the exception of tantalum, most of these metals are restricted to relatively low operating temperatures or low hydrochloric acid concentrations. Because of their freedom from thermal shock, dimensional stability, high thermal conductivity, and high strength, metals are widely used for heat transfer and container surfaces in such equipment as condensers, heat exchangers, heaters, thermowells, pumps and valves.

Use of high-cost metals is generally justified when lower cost materials fail to stand up to severe conditions such as high acid concentrations and temperatures, mechanical abuse and metal contamination.

Most corrosion data appearing in the literature come from short-term tests and can be seriously misleading if extrapolated to extended times, particularly if the solution contains other substances even in minor amounts. Nonetheless, these results are valuable as a rough guide in selection of materials for field tests.

▶ **Low Impurities, Low Corrosion**—The corrosion properties of zirconium, like most metals, are influenced by impurity content and the state of the metal surface in a given environment. Data in Table I demonstrate that a small decrease in impurity content, as indicated by a change to lower hardness values, produces a remarkable decrease in corrosion rate, accompanied by a change from intergranular pitting to uniform surface attack. Actually, vacuum-melted commercial-grade zirconium, containing about 2% hafnium, is available today in higher purity than the argon-melted commercial-grade zirconium referred to in Table I and throughout this article. Corrosion rates for the latter, which we will discuss, represent maximum values in uncontaminated hydrochloric acid service (more recent metallurgical practice has made zirconium available having the corrosion properties of the high-purity reactor-grade).

▶ **Breakaway Corrosion** — Surface condition has an important influence on the corrosion behavior of zirconium. This is shown for commercial-grade zirconium in boiling 20% HCl on Fig. 2 for three types of surface treatment.[6]

Curves 1 and 2 illustrate "breakaway" corrosion associated with as-received and abraded surfaces. In this mode of attack, initial corrosion is negligible, but after a period of time, there is a relatively sudden increase in rate of attack. Evidence suggests that breakdown of an impervious oxide film occurs at this time, allowing the electrolyte relatively free access to the metal surface. Zirconium hydride forms beneath the oxide film destroying coherency between metal and

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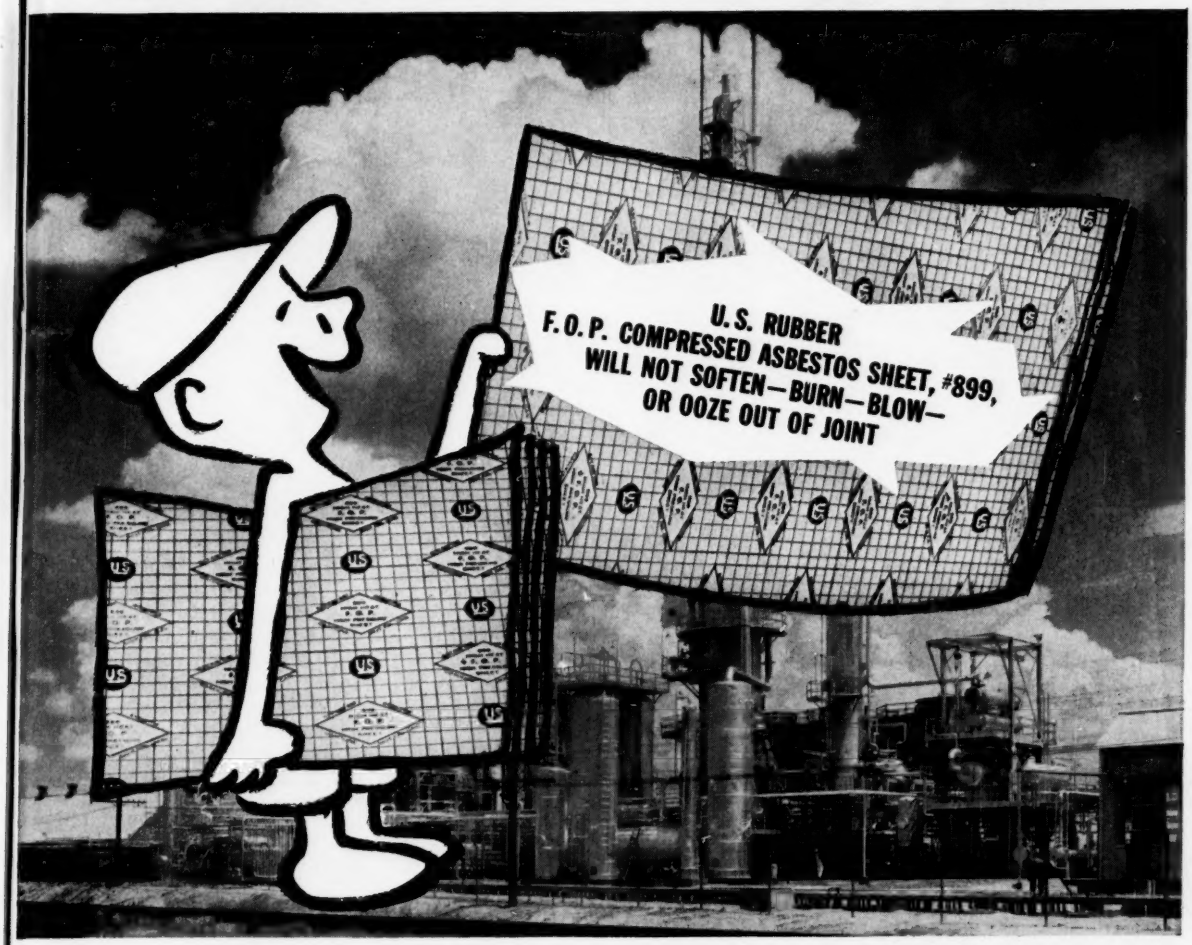

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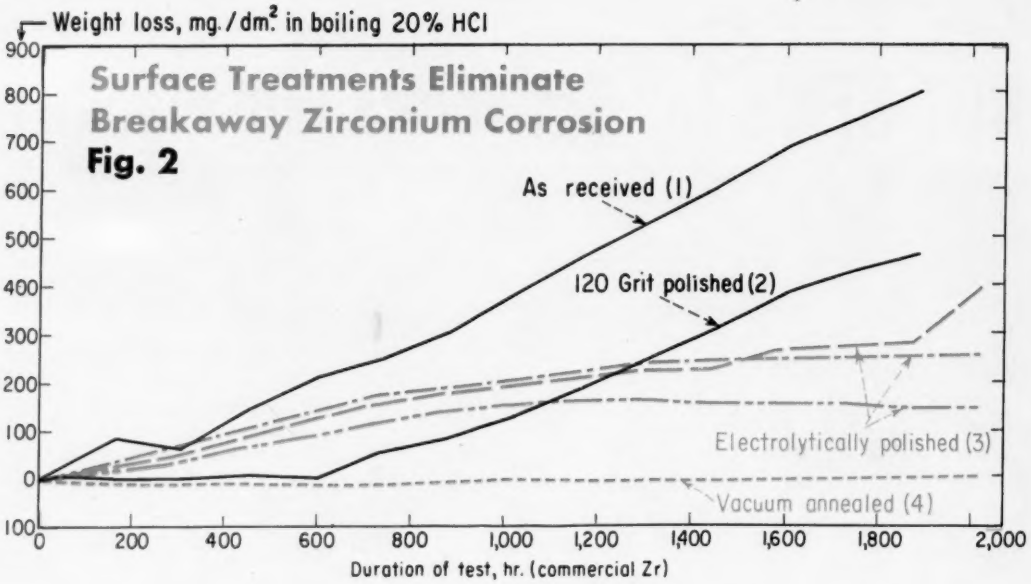


oxide film, causing rapid loosening and cracking of the film.[6]

The post-transition rate for "impure" commercial-grade Zr seldom exceeds 20.4 mg./dm.²/day or 4.5 mils/yr. in boiling hydrochloric acid of standard chemical purity for all concentrations up to 20% HCl. In general, corrosion rates are likely to be less than 4.5 mils/yr.

Higher purity zirconium in boiling hydrochloric acid has much lower corrosion rates than the commercial-grade argon-melted zirconium. Furthermore, breakaway in boiling 20% solutions has not been observed in the higher purity metal for periods over 1,000 hr.

Electrolyte polishing and vacuum annealing have a profound effect on corrosion rates, as shown in curves 3 and 4 of Fig. 2.

This knowledge emphasizes the importance of surface finish or treatment in determining the type of protective film formed on zirconium. Since a reliable process for forming a protective oxide film cannot be prescribed, estimates of corrosion loss should be based on nontreated surfaces and any extra protection can be regarded as a bonus.

► **Iron, Copper Effects** — This knowledge, however, does not allow us to predict the influence of impurities or additions of chemicals on corrosion behavior. For example, it is not uncommon to find iron, and in rarer circumstances copper, as an impurity in hydrochloric acid. Zirconium, as with many alloy steels, is sensitive to ferric ion contamination.

Effect of iron concentration in boiling 20% HCl on the rate of corrosion attack and depth of pitting of "impure" commercial Zr is shown in Table II. Pitting attack becomes increasingly severe as iron content goes up. However, the presence of 5 ppm. in boiling 20% hydrochloric acid has little influence on the corrosion rate and may even inhibit corrosion of electrolytically polished specimens. For some applications, amounts up to about 10 ppm. of iron may be tolerated, since depth of pitting is quite shallow.

Corrosion resistance to boiling 20% HCl containing 5 and 10 ppm. of copper is rated excellent. This is on the basis of 144-hr. tests giving low corrosion rates, shallow pitting, and full ductility. However, when 50 ppm. of copper are present, embrittlement, stress corrosion cracking, and increased pitting become evident, although the corrosion rate is less than 5 mils/yr.

► **Temperature Curves**—Fig. 1 shows how corrosion weight loss is affected by changes in the acid concentration at various levels of temperature. The set of curves is useful for determining degree of control over acid concentration needed to prevent excessive corrosion rates. To convert mg./dm.² in Fig. 1, to mils/yr. multiply by 0.111.

However, this high-temperature data apply to commercial zirconium of a particular analysis not representative of the improved grades available today. Table I shows the variation in corrosion properties at 200 C. between four grades of zirconium in hydrochloric acid; the iodide-grade, reactor and vacuum-melted grades have substantially better corrosion resistance than argon-melted commercial-grade zirconium.

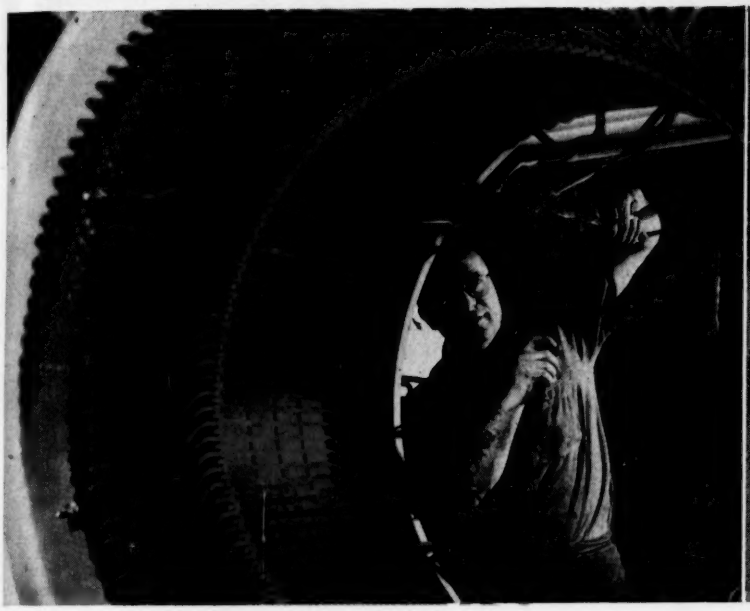
► **In Sulfuric and Nitric**—Zirconium, while well suited for hydrochloric acid service, also has good resistance to other media.[3, 4, 7, 8, 9] Metal impurities have less of an effect than in HCl.

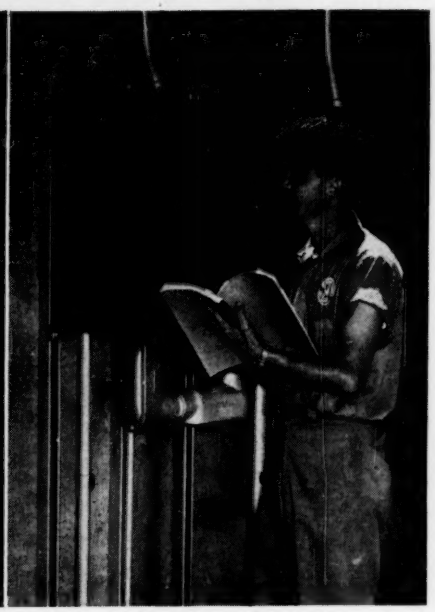
At 35, 60 and 100 C., corrosion rates are less than 1 mil/yr. in aerated sulfuric acid, up to concentrations of 75, 72.5 and 70% respectively. Beyond this, corrosion rates rise sharply.

For a corrosion rate of 5 mils/yr. or less in pure sulfuric,

SILICONE NEWS from Dow Corning

The Current Revolution





Silicone Insulated Equipment Brings Economy, Flexibility

Chances are you've heard of the current revolution in electrical equipment . . . of outdoor motors stripped of weatherproof housings . . . of motors that laugh at overloads . . . of smaller, lightweight transformers that put power right where you want it.

These developments typify three phases of today's growing trend toward electrical equipment that's more reliable and easier to install . . . less expensive initially and in the long run.

Phase I — Self-Protecting Insulation Cuts Motor Costs

Motors need no costly enclosures . . . even outdoors . . . when they've got self-protecting insulation systems. The insulation system itself, when made with Silastic®, the Dow Corning silicone rubber, shrugs off weather, humidity, corrosion . . . is no longer the "weak-link" to be coddled. Result: There's no need for the elaborate enclosures that push motor prices out of sight. Open motors do the job — costs are cut as much as 50%! Proof: One firm saved $28,000 on only three motors by specifying silicone insulated open motors rather than totally-enclosed fan-cooled units.

Phase II — Increased Service Factor Motors Reduce Power Costs

Motors with insulation systems that don't get "burned-up" when asked to carry overloads . . . that's one way of describing motors built with Dow Corning Silicones for extra service factor. When the going gets rough and production schedules are critical, they carry overloads of twenty-five to fifty percent beyond nominal rating . . . without distressing smoke signals. And though they deliver more horsepower when needed, they're still no bigger than their conventional counterparts . . . have the same nameplate horsepower rating. Result: You specify motors to match load, let silicones carry the overloads. No need for larger, more expensive motors just to handle occasional overloads . . . and you gain in reliability, too.

Phase III — Silicone Insulated Transformers Give Power Where You Want It . . . At Less Expense

New dry-type transformers insulated with silicones contain no toxic or flammable liquids. They're smaller, lighter . . . don't require expensive vaults or barriers. Result: Silicone insulated transformers are easier to handle, easier to install, can be located right at load or load center, need almost no maintenance. They save on costly low-voltage cable, too. You get greater flexibility of the distribution system and cut costs at the same time.

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Corrosion Rate of Zirconium Goes Up With Iron—Table II

Ferric Iron, (Ppm. in Acid)	Corrosion Rate* (Mils/Yr.)	Pit Depths* (microns) Avg.	Max.
nil	0.83	4	7
5	0.27	5.1	8
10	0.49	7.4	15
50	1.95	16.2	30
60	1.97	30.2	74
128	3.67	15.4	23
445	12.10	27.3	65
890	22.0	53.1	125

* 144 hour test, surface abraded with 3/0 polishing cloth, boiling 20% HCl on commercial-grade (argon) zirconium.

concentrations of 11, 15, 18, 28, 45, and 70% may be used up to temperatures of 250, 225, 200, 187.5, 175 and 150 C. respectively.

Chlorine-saturated solutions severely attack zirconium at sulfuric concentrations between 40 and 54%, but there is little attack in the 61 to 72% range.[7]

In nitric acid, zirconium shows excellent corrosion resistance. Commercial-grade is fully resistant to attack by aerated nitric at 35, 60 C. and boiling solutions up to 70%—the rate never exceeds 0.1 mil/yr. Exposures in plant nitric solutions, up to 65% at 265 F. shows little corrosion to zirconium.[7]

In 35 C. aerated phosphoric acid, zirconium has rates of less than 1 mil/yr. up to 80%; at 60 C. rates are less than 3 mils/yr. up to 60%. Pitting attack becomes more severe above 60 C. at 60%.

▶ **Fabrication Problems**—In the fabrication of zirconium process equipment two major problems are encountered:

- Contamination of metal with nitrogen, oxygen and hydrogen at high welding temperatures.
- Inability to weld zirconium to low-cost common materials of construction (carbon or stainless steel) without producing weak, brittle welds and weld metal having poor corrosion resistance.[10]

Generally, improper welding techniques cause zirconium to absorb gases and lose ductility, making bending and forming difficult. Also, corrosion resistance in certain media may be reduced by gas absorption. However, with proper shielding techniques, welds as ductile and corrosion resistant as the parent metal may be made. Such techniques involve inert gases to shield the underside and topside of the weld as metal is deposited.

▶ **Lining With Zr**—The problem imposed by the inability to weld zirconium to other materials may be overcome by securing a liner to the base metal by mechanical methods or by a special vacuum-bonding technique such as Hortonclad.[11]

Heat transfer could be a problem in a lined vessel if the lining and the base metal were not in contact at the higher temperatures. Good design overcomes this problem. At the higher temperatures, the base metal will expand to a greater degree than the zirconium due to differences in the coefficients of expansion of 11.7×10^{-6}/°C. for iron and 5.8×10^{-6}/°C. for zirconium. However, expansion of the zirconium liner under pressure would exceed the thermal expansion of steel. For very large vessels and under extreme conditions of temperature this situation could present some problems.

The difference of coefficients of expansion between zirconium and base metal, however, is not expected to present any difficulties in bonded-clad sheets.

▶ **New Concepts Needed**—Versatility of zirconium, coupled with imaginative engineering, should evolve new concepts in the design of chemical equipment.

It is feasible to consider a heat exchanger condensing chlorine-free hydrochloric vapors using strong alkalis as coolants. Plant exposures, at temperatures to 265 F., up to 200 days in solutions as high as 73% caustic, demonstrate that zirconium performs consistently well in most alkali solutions. Zirconium was also found to be the only material with a low corrosion rate in caustic in the presence of ammonia.[7]

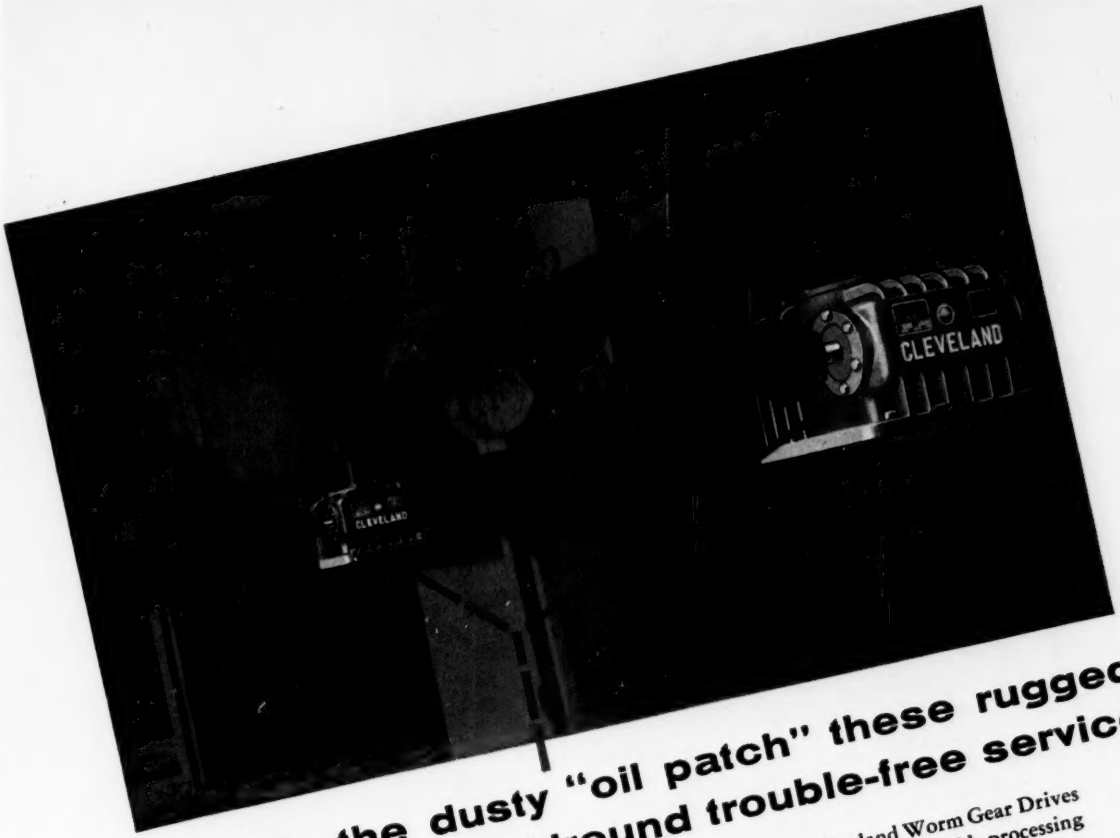
Zirconium reaction tanks may be used alternately in reducing or oxidizing mineral acids and for reactions involving strong alkalis and caustics. Zirconium's excellent corrosion resistance to sodium and sodium-potassium alloys, and fused salts permits use of these liquids as heat-transfer fluids in chemical systems.

Eco Engineering Co., on pumps, has found zirconium is as easy to machine as 303 stainless steel as well as giving longer tool life. This makes it attractive for quantity production with program machine tools. Another advantage claimed is that heat treatment is not required before or after machining, offsetting, somewhat, the higher cost of zirconium.

REFERENCES

1. Golden L. B., Lane, I. R., Ackerman, W. L., *Ind. Eng. Chem.* **44**, 1930 (1952).
2. Lane, I. R., et al, *Ind. Eng. Chem.* 45, 1067 (1953).
3. Golden, L. B., "Zirconium and Zirconium Alloys," p. 305, Amer. Soc. of Metals, Cleveland, 1953.
4. Golden, L. B., et al, *Ind. Eng. Chem.* **45**, 782 (1953).
5. Kuhn, W. E., "Arc Furnaces for Melting Titanium and Zirconium," chapter in "High Temperature Technology," edited by I. E. Campbell, Wiley, New York, 1956.
6. Kuhn, W. E., *Corrosion*, **15**, 19 (Mar. 1959).
7. Gegner, P. J., Wilson, W. L., The Corrosion Resistance of Titanium and Zirconium in Chemical Plant Exposures, *Corrosion*, **15** (July 1959).
8. Roach, J. D., *Chem. Eng.*, Sept. 1953, p. 309.
9. Cox, F. G., *Corrosion Prevention and Control*, Apr. 1958, p. 39 and June 1958, p. 46.
10. Payne, B. S., "Fabrication of Zirconium," Advanced Materials Technology, 2, No. 1 (Apr. 1959), available from The Carborundum Co., Niagara Falls, N. Y.
11. Davis, R. A., *Corrosion*, **15**, Oct. (1959).

W. E. KUHN holds the title of Supervising Engineer, Metallurgy Dept., in the Research and Development Div., The Carborundum Co. Mr. Kuhn has a B.S. in metallurgical engineering from the University of Toronto.



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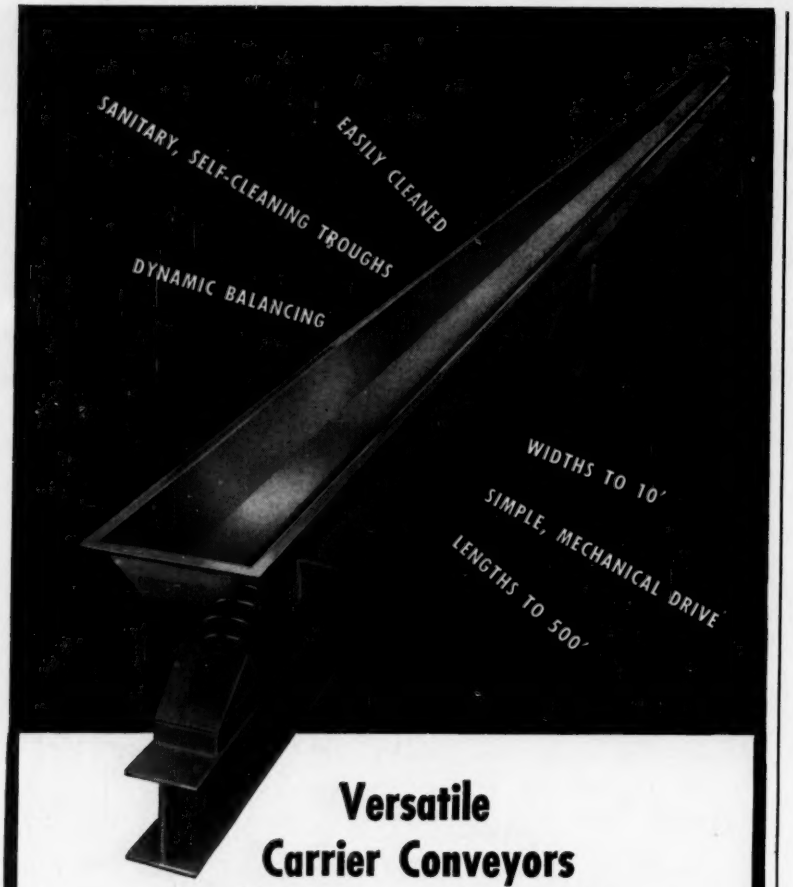

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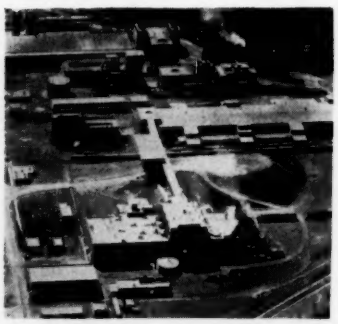
(*Continued from p. 72*)

tons/yr. By the middle of this year 20,000 tons/yr. of new capacity will go on stream; and by mid-1960 the other 18,000 tons/yr. will be in operation.

Reynolds Metal Co. will this summer begin construction of a 500-tons/yr. silicon alloy plant at Sheffield, Ala. Rising demand by the automotive industry for aluminum-hardening alloy spurred the construction planning. Reynolds' own engineering staff will design the furnace plant.

Jones & Laughlin Steel Corp. reveals plans for construction of a $9.5-million battery of byproduct coke ovens at its Pittsburgh, Pa., plant. Battery will consist of 118 smokeless ovens, will increase J & L's capacity to nearly 2-million tons/yr. of coke at the Pittsburgh plant.

Hooker Chemical Corp. plans construction of a potassium-phosphate plant at Jeffersonville, Ind., to be in operation by the middle of the year. New plant's principal product will be potassium pyrophosphate for sale to detergent producers.



Consolidated Mining and Smelting Co. has begun construction of $2.6-million alkali-chlorine plant at its Warfield Works near Trail, B. C. New unit will produce chlorine and caustic soda, for sale to Celgar, Ltd.'s nearby pulp and paper plant, and caustic potash for use at the Warwick Works, shown above.

Kaiser Aluminum & Chemical Corp. grasps a tighter hold of the sheet aluminum market by adding this giant 15,000-ton plate stretcher to its Ravenswood, W. Va., plant. Giant jaws are capable of stretching 60-ft.-long aluminum sheets nearly 10%; light sheet-aluminum is finding greater use in the process industries for tanks and process equipment.

Michigan Chemical Corp. announces plans for the doubling of bromine capacity at its El Dorado Ark., plant. Construction, which is already under way, is scheduled for completion by the summer.

Continental Oil Co. is preparing to produce petrochemical cyclohexane. Conoco is building a 20-million gal./yr. unit at its Ponca City, Okla., refinery to convert benzene to cyclohexane by hydrogen reduction. Procon, Inc., has begun construction, scheduled for completion by September.

Chemetron Corp.'s National Cylinder Gas Div. has placed on stream a new air-separation plant at Dallas, Tex. New plant produces high-purity liquid oxygen, argon and nitrogen.

Du Pont announces plans for construction of a large plant for recovery of alkylation sludge acid at La Porte, Tex. New plant will supply recovered sulfuric acid to Du Pont's new caprolactam

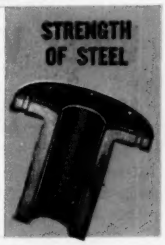
Life in these excited states...

"Have you seen the pipe inspector?"

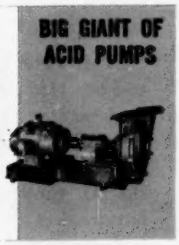
How Ace keeps you out of the tight spots

We admire men who jump right into the tough problems, but our business is eliminating problems completely. That is, problems of corrosion and contamination in piping, valves, pumps, tanks, and the like. Good equipment keeps you always in the clear. Our 108 years of experience is at your service.

Ace chemical-resistant rubber-lined steel pipe best for high-pressure, big sizes, or abrasives. Pipe, fittings and valves 1½ to 24".



Highly efficient *WE* pump. Capacity to 360 gpm. Cast iron, fully protected by top quality, chemical resistant hard rubber lining.

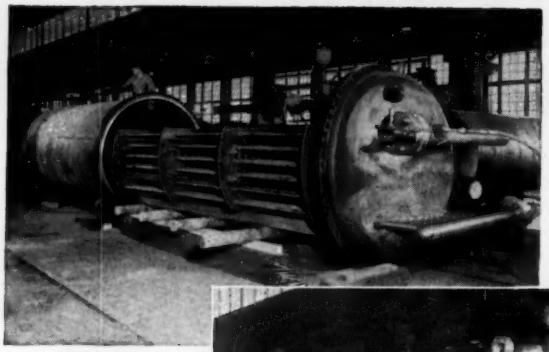


Design assistance and facilities for molding special fittings, pump parts, etc., of plastics or hard rubber. Also large hand-fabricating facilities.

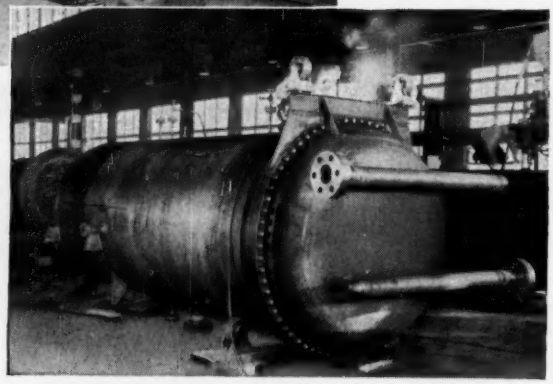
Variety and quality to match *any* plastic piping. Riviclor PVC, Ace-Ite rubber-plastic, Parian poly, Ace Saran, Tempron high temperature nitrile, hard rubber-lined steel.

ACE processing equipment of rubber and plastics

AMERICAN HARD RUBBER COMPANY
DIVISION OF AMERACE CORPORATION
Ace Road • Butler, New Jersey



View showing how tube bundle slides out for ease of cleaning.



Vilter Synthesis Heat Recovery unit for Canadian chemical plant. Rollers being welded in place.

Vilter Vessel Salvages "Waste Heat" While Desuperheating Ammonia Gas!

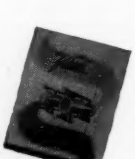
This Vilter synthesis heat recovery unit makes every BTU do double duty. Using waste heat from mixed synthesis and ammonia gas, this vessel vaporizes water at 45 psi to steam at the rate of 6640 pounds per hour. In the process the gas at 4800 psig is cooled from 495° F. to 328° F. The steam is then used in other plant operations.

This Vilter unit weighing 15 tons is 72" in diameter, 17' long, and has 1150 lineal feet of tubing. Croloy tubing and headers are used because at temperatures over 500° F. carbon steel would be de-carbonized by the nitrogen-hydrogen mixture. Shell and cover are of welded steel for tightness and strength. For easy cleaning, the "U" tube bundle slides out on rollers. This heat recovery unit is typical of the custom work Vilter is doing in the field of heat exchangers and pressure vessels to meet design and budget requirements.

Vilter can give you the most efficient heat exchanger equipment with working pressures as high as 10,000 psi. Vessels are built in conformance to the A.S.M.E. Code and when specified to T.E.M.A. standards.

Consult with Vilter for your special vessel needs.

Write for your free copy of this helpful bulletin to The Vilter Manufacturing Company, Dept. K-811, 2217 S. First Street, Milwaukee 7, Wisconsin.



Bulletin 827 Vilter Industrial Heat Exchangers

Vilter®

REFRIGERATION and AIR CONDITIONING

THE VILTER MANUFACTURING COMPANY, Milwaukee 7, Wisconsin

Air Units • Ammonia & Freon Compressors • Booster Compressors • Baudelot Coolers • Water & Brine Coolers • Blast Freezers • Evaporative & Shell & Tube Condensers • Pipe Coils • Valves & Fittings • Pakice & Polarflake Ice Machines

plant, now under construction at Beaumont, Tex.

Cottler Corp., Canon City, Colo., will expand its 50-tons/day pilot unit to a 200-tons/day uranium processing mill. New AEC contract for purchases of uranium concentrate precipitated expansion plans.

Cooper-Bessemer Corp., Mount Vernon, Ohio, is establishing new production capacity to facilitate compressor sales in Canada. C-B will soon move into existing manufacturing facilities of Canadian National Railway at Stratford, Ont.

Standard Oil Co. of Calif. has begun construction of a 10,000-tons/yr, maleic anhydride plant at its refinery near Richmond, Calif. Badger Mfg. Co. is building this contribution to the maleic anhydride boom (*Chem. Eng.*, Dec. 14, 1959, pp. 78-82).

Continental Can Co. plans construction of a $1.5-million research and development laboratory adjoining its new Plainfield, Ill., manufacturing facility. New Continental research efforts aim at development of new techniques for forming and treating glass containers.

Matheson Co. is expanding into Canada, will build a compressed gas plant in Ontario, Que., by the summer to supply some 80 gases in a variety of cylinder sizes.

Ultrasonics Industries, Inc. has been formed to manufacture ultrasonic cleaning devices. New plant is located at Albertson, N. Y.

Wyandotte Chemicals Corp. reaches to foreign markets, has formed Wyandotte Chem-

Some Straight Talk On Steam Trap Capacity

... or pulling away the curtain of confusion that surrounds steam trap capacity ratings.

Unfortunately, for the steam trap buyer, the subject of steam trap capacity has become cloudy and confused by a landslide of claims, counter-claims and inconsistent "standards" for measurement. So let's take a cold hard look at this subject so vital to the efficient operation of your plant.

What Determines Steam Trap Capacity?

There are three factors that determine the capacity of a steam trap:

1. The area of the orifice.
2. The density of the condensate.
3. The pressure differential across the trap.

Let's take a closer look at each of these:

Area of orifice is usually specified by the trap manufacturer or can be calculated from the diameter. Nothing complicated here.

Density of condensate depends on temperature. A cubic foot of cold water weighs 62.4 lbs. At 250° F. or 15 psi, it weighs less than 59 lbs. This is important. Don't overlook it.

Pressure differential across the trap is most significant. And it is complicated by the many factors that affect it, such as:

1. Pressure drop between unit drained and the trap when the trap valve is open.
2. Distance the trap valve is moved from the valve seat.
3. Back pressure on the trap with orifice closed; i.e., return header pressure.
4. Increase in back pressure produced by condensate and flash steam flowing in the discharge line. This in turn is affected by the diameter and length of the discharge line, plus friction caused by valves and fittings.

Orifice Capacity Vs. Steam Trap Capacity

Figure 1 shows a ½" diameter sharp-edged orifice at the end of a pipe filled with cold water at 15 lbs. pressure. The capacity of this orifice, using a .61 coefficient of flow would be 8,800 lbs. per hr. Now, would this ½" orifice if used in a ¾" steam trap installed as shown in Figure 2 provide the trap with a continuous discharge capacity of 8,800 lbs. of hot condensate per hour? The answer is "no". And here are some of the reasons why:

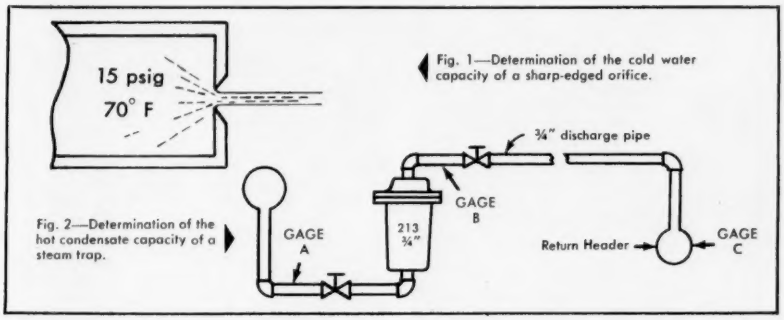


Fig. 1—Determination of the cold water capacity of a sharp-edged orifice.

Fig. 2—Determination of the hot condensate capacity of a steam trap.

Density of condensate. As pointed out above, cold water weighs 62.4 lbs. per cu. ft. At 15 lbs. pressure and 250° F. water weighs less than 59 lbs. per cu. ft. This difference in density alone reduces the lbs. per hour capacity of the orifice by over 5%.

Pressure differential across the trap. With the trap valve closed we have a static pressure differential of 15 psi. The trap valve must be able to open against this pressure. However, this is not the pressure differential that will determine the capacity of the trap valve.

The ¾" discharge line will be full of a mixture of flash steam and condensate. To keep this mixture flowing from the trap outlet to the return line requires a pressure differential. In actual capacity tests run as shown in Figure 2 Gage B at the trap outlet registered 11 lbs. back pressure. Thus the true pressure differential across the trap was about 4 lbs. Under these conditions the measured capacity of the trap was 4,340 lbs/hr. or just about half of the capacity of the ½" orifice for cold water.

How Armstrong Determines Capacity Ratings

Armstrong trap capacity ratings are based on hundreds of tests under actual operating conditions. In these tests, the condensate used was at the steam temperature corresponding to the test pressure. Thus, the capacities determined take into account the pressure drop that occurs when the trap orifice opens and the choking effect and back pressure of the flash steam. Actual installation hook-ups were used so that pipe friction in both inlet and discharge lines as well was reflected in the results.

Let's go back to the example cited above and in Figure 2. The trap referred to is an Armstrong No. 213. While it did test out at 4,340 lbs. per hour for a static pressure differential of 15 psi, it is rated in the catalog at only 3900 lbs. per hour for this pressure—just to be on the safe side.

For the trap buyer, this means that Armstrong Steam Trap capacities are based on handling condensate at steam temperature for the stated static steam pressure differential under actual working conditions.

Capacity ratings which don't take into account all of the variables will be misleading and may lead to the selection of undersized traps. So whenever you specify or buy traps be sure that the capacity ratings you work from are realistic. One way to be sure is to select Armstrong Traps with *guaranteed* capacity ratings.

* * *

Additional information on trap capacity ratings, plus data on how to correctly size, install and maintain steam traps for any pressure, any temperature and any load, are presented in the 48-page Armstrong Steam Trap Book. Ask your local Armstrong Representative for a copy or write:

Armstrong Machine Works
8586 Maple Street
Three Rivers, Michigan

ARMSTRONG STEAM TRAPS

See our catalog in Chemical Engineering Catalog

Refinery licks tough heat exchanger crisis with emergency tube service

A sudden tube failure at the Pure Oil Company's Refinery in Lemont, Illinois, recently put Bridgeport's condenser tube service to the test. The failure hit on Friday afternoon—just before business slowed down for the week end. Faced with the prospect of costly equipment down time, the refinery called Bridgeport's Chicago office to find out how fast new tubes could be supplied. Here's a round-the-clock story of how the emergency was licked.

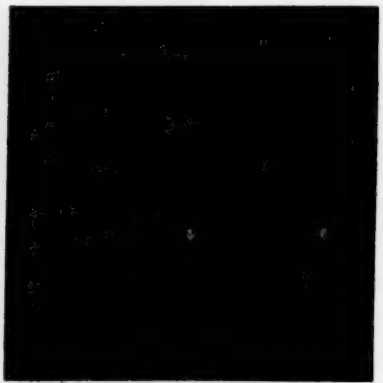
Friday, 2:30 P.M.: Salesman from Bridgeport's Chicago office learns that Pure Oil needs 900 Admiralty condenser tubes, and fast.

Friday, 3:00 P.M.: Salesman contacts our Bridgeport, Connecticut, mill and is informed that order can be delivered to Pure Oil Refinery in one week.

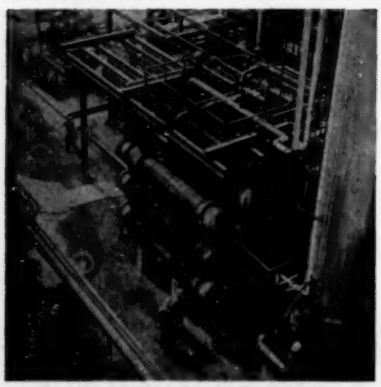
Friday, 3:30 P.M.: Sudden change in customer's needs makes immediate delivery of tubes imperative.

Friday, 4:15 P.M.: Chicago office checks through coast to coast network of Bridgeport warehouse stocks. Locates tubes at Beaumont, Texas.

Friday, 4:30 P.M.: Special night shift at Beaumont is put on job to cut tubes to special lengths and pack for shipment.



Saturday, 4:00 A.M.: Special truck leaves Beaumont, Texas, with order for Pure Oil Refinery in Lemont, Illinois.



Sunday, 11:30 P.M.: Truck arrives at Lemont Refinery with 900 Admiralty tubes, ready for repair work to start Monday morning.

While emergencies like this don't happen every day, they do prove dramatically that Bridgeport's customer service can come to the rescue. When we talk about fast service from our network of sales offices and warehouses, we mean it. Let us tell you more about our service on your condenser and heat exchanger tube needs, whether they're emergencies or normal deliveries. Call your nearest Bridgeport Sales Office, or get in touch with us direct.

Write for your free copy of Bridgeport's Condenser and Heat Exchanger Tube Handbook. Address Dept. 5002.

BRIDGEPORT BRASS COMPANY

Bridgeport 2, Connecticut • Sales Offices in Principal Cities

*Specialists in Metals from **A**luminum to **Z**irconium*

icals International, Inc., with headquarters at Windsor, Ont. New company is chartered under the laws of the Republic of Panama.

Nopco Chemical Co. announces that its subsidiary, Metasap Chemical Co., has become a Nopco division.

Stauffer Chemical Co. has acquired the Plastic Pipe and Tube Div. of the Anesite Co., Santa Barbara, Calif. With its newly required know-how Stauffer becomes a producer of extruded plastic pipe and fittings.

OVERSEAS BRIEFS

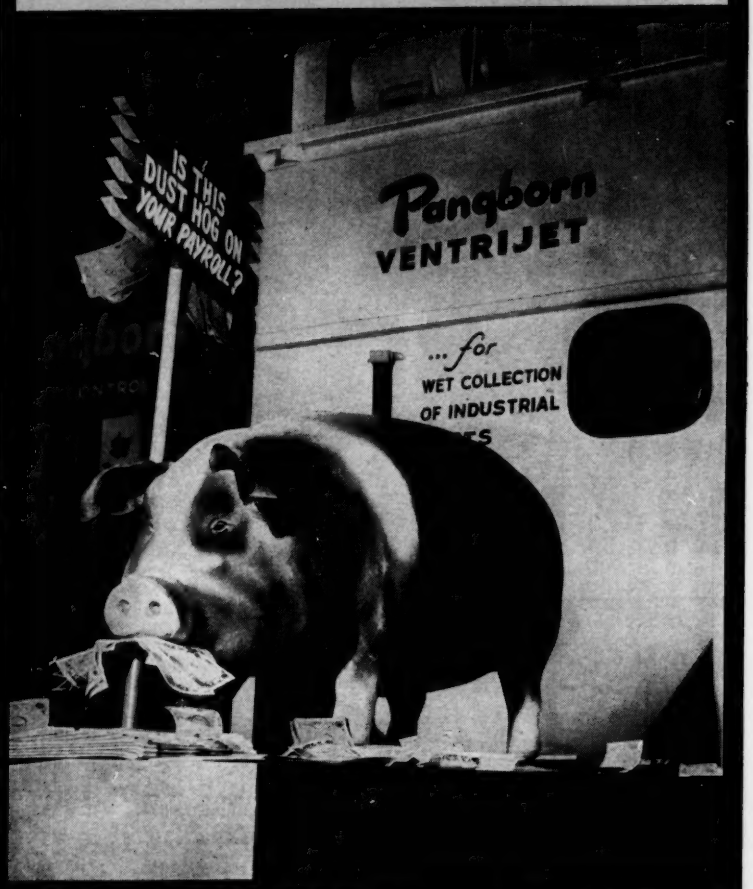
Netherlands: Emery Industries of Cincinnati, Ohio and Unilever N. V. of Rotterdam have joined forces to construct a plant for ozone oxidation of fatty acids at Rotterdam. Unilever has acquired Gouda-Apollo of Rotterdam to supply fatty acid feed material.

Yugoslavia: Fabrika Azotnih Dubriva announces plans for construction of a high-pressure desulfurizing unit to handle 2,500 lb.-moles/hr. of synthesis gas. Pintsch Bamag A. G. of West Germany is building the plant, to use the Alkazid process and to be completed in 1960.

Japan: Showa Denko, K. K., is building a carbon black plant at an undisclosed site, to produce oil furnace black for sale to the rubber industry. Showa Denko will employ a process licensed by Phillips Petroleum Co.

Pakistan: American Cyanamid Co. announces plans for construction of a $500,000 pharmaceutical plant at Karachi. Plant is scheduled to go on stream by the fall, will produce antibiotics, sulfa drugs and nutritionals.

IF THERE'S A DUST HOG ON YOUR PAYROLL...



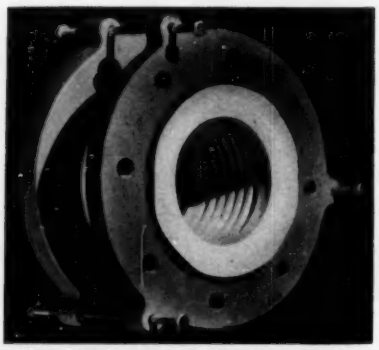
. . . let Pangborn Dust Control stop this waste!

Dust Hogs eat away profits! See for yourself—add up the cost of your lost salvageable material, housekeeping expenses, excess machine wear, intangibles such as community and employee goodwill. Whether your cost of feeding a Dust Hog is moderate or high, Pangborn Dust Control will cost you *less* than you are now paying for uncontrolled waste.

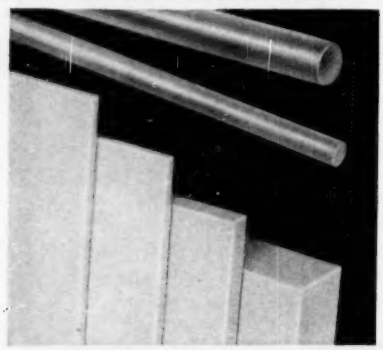
For details on Pangborn's engineering knowledge and experience, talk to the Pangborn man in your area or write PANGBORN CORPORATION, 2600 Pangborn Blvd., Hagerstown, Md. *Manufacturers of Dust Control and Blast Cleaning Equipment—Rotoblast® Steel Shot and Grit.* ™

Pangborn CONTROLS DUST

*du Pont Trademark



EXPANSION JOINTS • FLEXIBLE COUPLINGS



SHEETS • RODS • TAPES

Belmont Distributors in 132 key industrial areas throughout the United States can offer fast delivery of the TEFLON Products shown here because Belmont backs them with vast stocks of the most popular sizes ready for immediate shipment.

TEFLON ENVELOPE GASKETS: Round—eleven popular sizes: 1½ x 1⅞ to 8 x 11. Oval—12 x 16 x 1½. Variety of filler materials.

TEFLON EXPANSION JOINTS: Nominal pipe sizes: 1″, 2″, 2½″, 3″, 6″.

TEFLON FLEXIBLE COUPLINGS: Nominal pipe sizes: 1″, 1½″, 2″, 3″.

TEFLON SHEET: 24″ x 24″ in thicknesses 1/32″, 1/16″, 1/8″, 3/16″, 1/4″, 1/2″. 36″ x 36″ and 48″ x 48″ in thicknesses 1/16″ and 1/8″.

TEFLON TAPE: 12″ continuous width in thicknesses .010″, .020″, .030″. 24″ continuous width in thicknesses .010″, .015″, .030″, .060″.

TEFLON ROD: Lengths to 6 ft. in nominal rod sizes 3/16″ to ½″ in 1/16″ increments; ½″ to 1¼″ in 1/8″ increments; 1¼″ to 2″ in ¼″ increments.

Ask your nearest Belmont Distributor for a complete stock list. You will find him in our insert in the Packing Section of Conover-Mast Purchasing Directory.

The Belmont Packing & Rubber Co.
Butler & Sepviva Sts., Phila. 37, Pa.

BELMONT

CALENDAR

Symposium on Gas-Cooled Nuclear Reactors, Franklin Institute-American Nuclear Society.
Feb. 10-11 Philadelphia, Pa.

American Institute of Mining, Metallurgical and Petroleum Engineers, annual meeting, Statler McAlpin Hotel.
Feb. 14-18 New York, N. Y.

The Australasian Institute of Mining & Metallurgy, Symposium on Hydrometallurgy, S. Australian Dept. of Mines.
Feb. 16-19 Thebarton, Australia

National Society of Professional Engineers, winter meeting, Broadview Hotel.
Feb. 18-20 Wichita, Kan.

American Institute of Chemical Engineers, national meeting, Biltmore Hotel.
Feb. 21-24 Atlanta, Ga.

Technical Assn. of the Pulp and Paper Industry, annual meeting, Commodore Hotel.
Feb. 22-25 New York, N. Y.

Weed Society of America, biennial meeting, Cosmopolitan Hotel.
Feb. 22-25 Denver, Colo.

National Council for Stream Improvement, annual meetings, Waldorf Astoria Hotel.
Feb. 22-25 New York, N. Y.

Natural Gas Engineering Conference, Oklahoma State University.
Feb. 23-25 Stillwater, Okla.

Pittsburgh Conference on Analytical Chemistry and Spectroscopy, Penn-Sheraton Hotel.
Feb. 29-Mar. 4 Pittsburgh, Pa.

American Institute of Chemical Engineers, New York Section, lecture series: "You, Dollars and the CPI." Texaco auditorium, Tues. evenings starting
March 1 New York, N. Y.

American Society of Mechanical Engineers, Gas Turbine Power conference and exhibit, Rice Hotel.
Mar. 6-9 Houston, Tex.

American Society of Mechanical Engineers, Hydraulic Conference, Rice Hotel.
Mar. 6-9 Houston, Tex.

Instrument Society of America, Temperature Symposium, Deshler-Hilton Hotel.
Mar. 9-11 Columbus, Ohio

American Concrete Institute, annual convention, Commodore Hotel.
Mar. 14-17 New York, N. Y.

National Assn. of Corrosion Engineers, 16th annual meeting, Memorial Auditorium.
Mar. 14-18 Dallas, Tex.

Colorado Mining Assn., national Western Mining and Energy Conference, Hilton Hotel.
Mar. 17-19 Denver, Colo.

Institute of Radio Engineers, national convention, Waldorf Astoria Hotel & New York Coliseum.
Mar. 2-24 New York, N. Y.

Oil Trades Assn. of New York, meeting, Waldorf Astoria.
Mar. 23 New York, N. Y.

New England Gas Assn., annual meeting, Statler-Hilton Hotel.
Mar. 24-25 New York, N. Y.

Textile Research Institute, annual meeting, Hotel Commodore.
Mar. 24-25 New York, N. Y.

Western Petroleum Refiners Assn., annual meeting, Hilton Hotel.
Mar. 28-30 San Antonio, Tex.

American Institute of Chemical Engineers, Philadelphia-Wilmington Section, all-day meeting: Separation Processes, University of Pennsylvania.
March 29 Philadelphia, Pa.

American Power Conference, sponsored by Illinois Institute of Technology, Hotel Sherman.
Mar. 29-31 Chicago, Ill.

American Oil Chemists Society, meeting, Baker Hotel.
April 3-6 Dallas, Tex.

Nuclear Congress, sponsored by Engineers' Joint Council and Engineering and Scientific societies, New York Coliseum.
April 3-8 New York, N. Y.

American Oil Chemists Society, annual meeting.
April 4-6 Dallas, Tex.

Instrument Society of America, New Jersey Section, all-day symposium: Computers in the Process Industry, Essex House.
April 5 Newark, N. J.

Instrument Society of America, National Chemical and Petroleum Symposium.
April 5-7 Rochester, N. Y.

American Society of Mechanical Engineers-Society for Advancement of Management, Management conference, Statler-Hilton Hotel.
April 7-8 New York, N. Y.

Management Seminar, sponsored by Cornell University, fee: $900, Statler Inn, Cornell Campus.
April 13-26 Ithaca, N. Y.

American Society of Mechanical Engineers-Institute of Radio Engineers-American Institute of Electrical Engineers, third annual conference on Automatic Techniques, Cleveland-Sheraton Hotel.
April 18-19 Cleveland, Ohio

American Society of Lubrication Engineers, annual meeting and exhibit, Netherland-Hilton Hotel.
April 19-21 Cincinnati, Ohio

Oklahoma State University, heat-transfer conference.
April 20-22 Stillwater, Okla.

National Petroleum Assn., semi-annual meeting, Cleveland-Sheraton Hotel.
April 20-22 Cleveland, Ohio

Instrumentation for the Process Industries, symposium sponsored by Texas A. & M.
April 20-22 College Station, Tex.

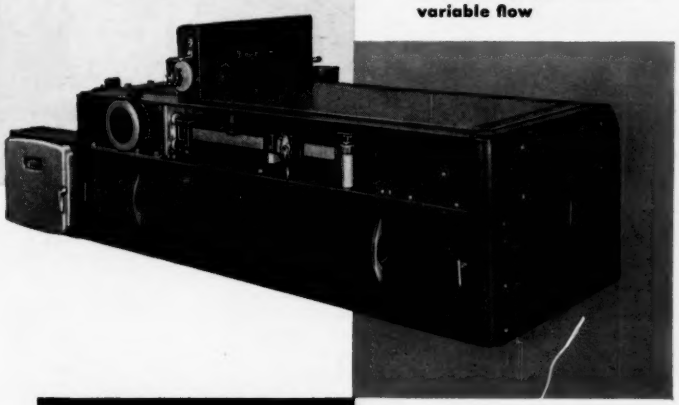
American Society of Mechanical Engineers, Maintenance and Plant Engineering Conference, Chase-Park Plaza.
April 25-26 St. Louis, Mo.

Natural Gasoline Assn. of America, annual convention, Rice Hotel.
April 27-29 Houston, Tex.

POSITIVE CONTROL OF MATERIALS IN MOTION BIF METERS FEEDERS CONTROLS

B-I-F BELT WEIGHER SOLVES PROCESS MEASUREMENT AND CONTROL PROBLEMS

- Checking production line output
- Checking in-plant inventory
- Weighing incoming and outgoing bulk shipments
- Evaluating process efficiency
- Density checking
- Batch weighing
- Signal producing for pacing additive materials proportional to a variable flow



CASE STUDY No. 1

BIF Omega **Pneu-Weigh Belt Weigher** checked production line output of 50 volumetric feeders to maintain critical limits . . . reduced plant downtime, lost man hours and production holdups!

Each feeder on proportioning line of a major formulator was putting out particular fraction of formula on continuous basis. Pneu-Weigh, installed at end of collector conveyor to "watchdog" operation through remotely located instrument, indicated less-than-expected output. A check revealed delivery rate of one volumetric feeder crtically lower than its limit. Result: over 100 tons of formulated product saved from being remade at considerable expense in plant time, man-hours, planning, removal of paper-bag packages, and subsequent resacking.

You'll find opportunities for cutting costs and improving efficiency in process feeding when you consult B-I-F — manufacturer of the most complete line of solid and liquid feeders and weighers.

B-I-F **Industries**

BUILDERS-PROVIDENCE • PROPORTIONEERS • OMEGA

METERS • FEEDERS • CONTROLS / CONTINUOUS PROCESS ENGINEERING

Pneu-Weigh offers extremely high accuracies, wide ranges, capacities in compact, uncomplicated unit. Request Bulletin 36.20-1 for details. Write **B-I-F Industries, Inc., 369 Harris Avenue, Providence 1, R. I.**

THIS PUMP SPECIALIZES IN

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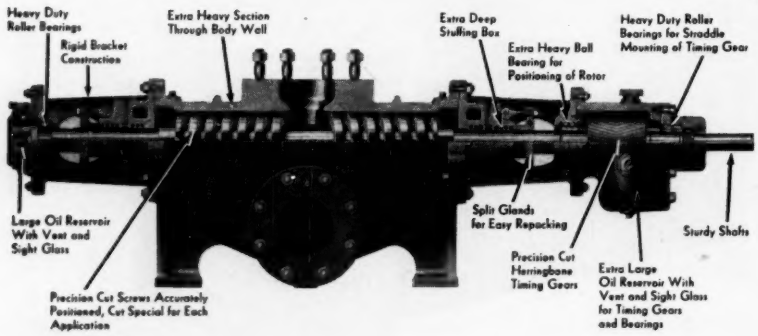
CHEMICAL PUMPING PROBLEMS

. . . examine these special features of the

WARREN

EXTERNAL GEAR AND BEARING

SCREW PUMP


Heavy Duty Roller Bearings
Rigid Bracket Construction
Extra Heavy Section Through Body Wall
Extra Deep Stuffing Box
Extra Heavy Ball Bearing for Positioning of Rotor
Heavy Duty Roller Bearings for Straddle Mounting of Timing Gear
Large Oil Reservoir With Vent and Sight Glass
Split Glands for Easy Repacking
Sturdy Shafts
Precision Cut Herringbone Timing Gears
Extra Large Oil Reservoir With Vent and Sight Glass for Timing Gears and Bearings
Precision Cut Screws Accurately Positioned, Cut Special for Each Application

. . . then see what it can do:

- Pumps highly viscous liquids or semi-liquids most effectively; discharge pressures nearly unlimited for high viscosity liquids; up to 700 psig for low viscosity liquids, with capacities to 3000 GPM and operating temperatures to 700°F.
- Pumps liquids from systems under high vacuum, with special modifications; has handled vacuums down to 10 microns, with no special seals or without submerging the pump. Mechanical seals are not required.
- Pumps many types of slurries, since it does not trap liquids as gear pumps commonly do.
- Pumps with a constantly high volumetric efficiency because of low internal slippage; is excellent for metering large capacities.
- Pumps quietly and smoothly and is ideal for extruding material where a flawless surface is necessary.
- This highly adaptable Warren External Gear and Bearing Screw Pump, available in an almost endless number of patterns, can solve special space or piping problems too. And it can be furnished with heating or cooling jackets, with hopper type body, and in any metal your problem requires.

Now, consult a Warren engineer for help with your "impossible" chemical pumping problem or write for detailed Bulletin 206

WARREN

CENTRIFUGAL SCREW RECIPROCATING GEAR

WARREN PUMPS, INC.

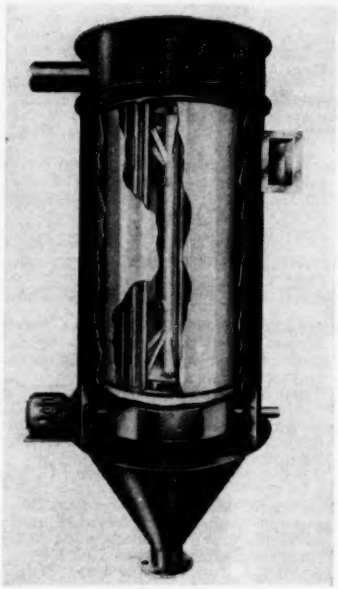
WARREN, MASSACHUSETTS

C-10

NEW EQUIPMENT . . .

(*Continued from p. 88*)

moves up or down with the float, movement is duplicated by "follower" magnets encased in the arm of the transmitter. This action controls a ball pilot in the transmitter unit.—**Schutte & Koerting Co., Cornwell Heights, Pa.** 88D



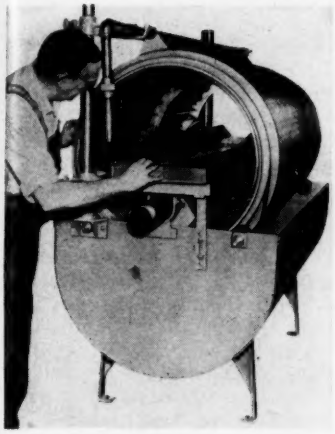
Dust Collector

Basically new design. High air/cloth ratio.

Particulates entering the new Roto-Jet cloth dust collector are immediately subjected to strong centrifugal action. This effect separates much of the dust before it ever reaches the cloth, and is one of several reasons for an unusually high air/cloth ratio and reduced space requirements for the over-all unit.

Other reasons derive from rotating blow tube and roller support system that requires neither reversing mechanism nor switches, and that provides a uniform cleaning time for each segment of the cloth.

Three Roto-Jet collector sizes are available; small, medium and large, with respective maximum capacities of 1,000 1,500 and 2,000 cfm.—**Dustex Corp., Buffalo, N. Y.** 170A

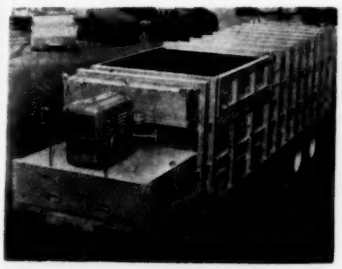


Self-Cleaning Strainer

Removes foreign solids from process liquids.

Adaptable to any phase of production operations requiring the straining of liquids, Sinclair Co.'s new self-cleaning strainer is offered in 40- and 100-gpm. sizes. Materials of construction include stainless, bronze and red-brass.

In operation, liquid undergoing cleanup first passes through a fine rotating wire-cloth strainer to eliminate all foreign matter. Then a set of shower nozzles automatically cleans the screen. Waste deposits in a refuse tray, and drains off into a sewage system. —The Sinclair Co., Holyoke, Mass. 71A



Compaction Trailer

Compresses plant waste into smaller volumes.

Designed for manufacturers that generate huge quantities of waste, or who face the problem of long hauls to refuse disposal areas, a new, hydraulic,

Why NINE?

A good question: *why* do we have nine different temperature regulators, when *one* should do the job?

Because one *can't* do the job: there are too many jobs, with too many different needs.

Even with nine it could be a problem—except for our flexibility of design that provides for almost limitless variations on the basic models.

Whatever your temperature problem, we think you'll find the answer here. Let's check 'em out! . . .

1001 Series: Wide temperature ranges from −30°F. to 480°F. Valve sizes ¼" to 2" single seated; ¾" through 4" double seated; ¼" through 2" three-way. Smallest practical bulb size; wider proportional band for stability.

1003 Series: 55°-60°F. adjustable ranges from −25° to 455°F. Valve sizes ¼" through 2" single; ¾" through 4" double; ¼" through 3" three-way. Small bulb size; intermediate proportional band. Indicating thermometer optional. Commonly used sizes and ranges available from stock.

1004 Series: For larger valves or higher pressure drops. Narrow proportional band. 40°F. adjustable ranges, −35 to 425°F. Valve sizes ¼"-2" single; ¾"-6" double; ¼"-6" three-way. Thermometer optional.

1006 Series - 1007 Series: Fail-safe; damage to thermal system automatically opens or closes valve as required. 30°F. adjustable ranges, −50 to 325°F. Valve sizes (1006): ¼"-¾" single; ¾"-2" double — (1007): ¼"-2" single; ¾"-4" double; ¾"-3" three-way.

1008 Series: Crank provides quick adjustment of control point. Same characteristics and valve sizes as 1003. Thermometer optional.

1009 Series: Crank for manual positioning of valve during start-up or abnormal conditions. Same characteristics and sizes as 1003. Thermometer optional.

1010 Series: Our biggest regulator . . . designed exclusively for 3" through 6" three-way valves. Manual valve positioner.

1011 Series: Unique all stainless steel regulator for corrosive locations. Same characteristics and sizes as 1003.

No other manufacturer offers such a variety of temperature regulators designed for specific needs. Write today for full specifications.

Ask for Catalog D-CC.

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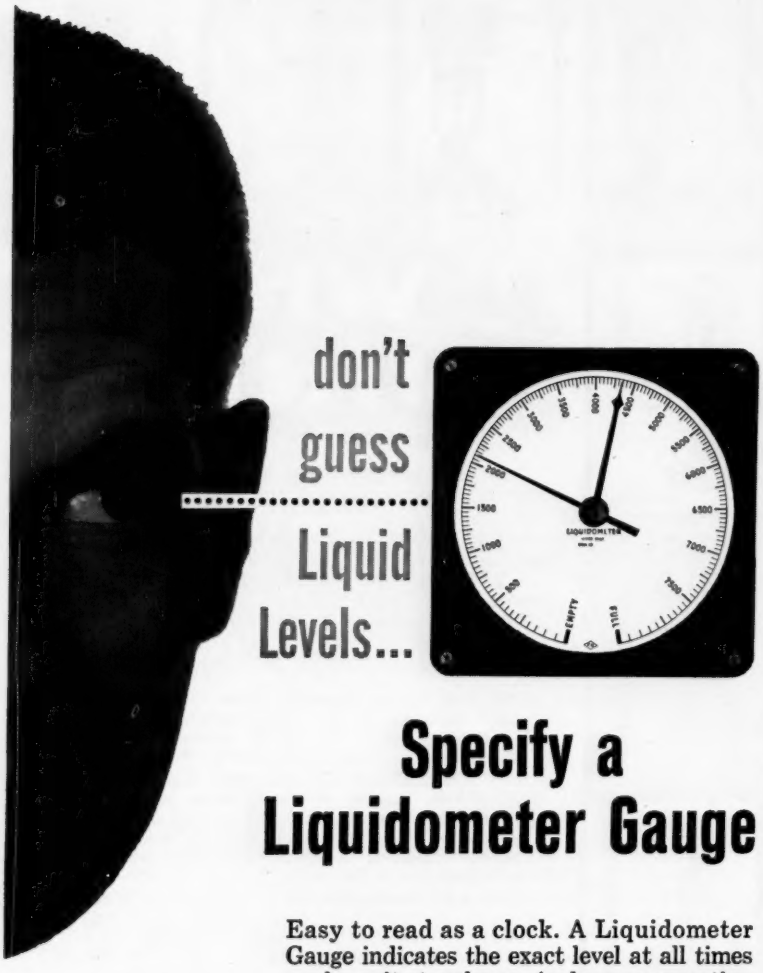

Specify a Liquidometer Gauge

Easy to read as a clock. A Liquidometer Gauge indicates the exact level at all times ... shows it at a glance. And gauge operation is completely automatic—as far as 250 feet from the tank—without need for auxiliary power of any kind.

A Liquidometer Tank Gauge measures virtually any liquid. It's simple to install—requires no maintenance. Many have provided over 30 years of efficient, dependable service. All are approved by Underwriters' Laboratories and Factory Mutual.

Whether your gauging needs require an automatic Liquidometer Gauge, a hydrostatic Levelometer or a tank-site-indicating Direct Reader, you'll get the best by specifying Liquidometer. For complete details write Dept. Q

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LONG ISLAND CITY 1, NEW YORK

compaction trailer compresses chemical plant waste, trash and refuse to a fraction of its former volume. Plants already owning their own detachable container system for refuse storage may use these containers in conjunction with the new trailer by application of ramps or extended-mast trucks.

Two models are available: Model DB-42 will hydraulically pack approximately 160 cu. yd.; Model DB-53 will hold approximately 210 cu. yd. of loose refuse. Compacting operation of the trailer is completely hydraulic—there are no chains, brackets or cables. Unit can be handled on any standard fifth-wheel tractor or tandem tractor. **—Dempster Bros., Knoxville, Tenn.** **171B**

Adjustable Drives

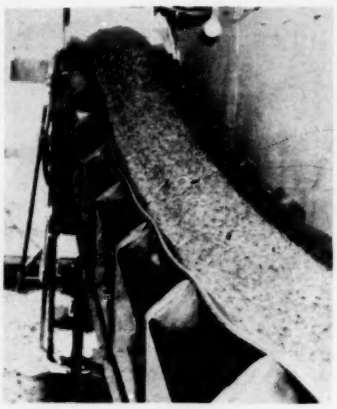
Manufacturer introduces entirely new line.

Designed for versatile performance in a broad range of general-purpose industrial applications, GE's new line of eddy-current-coupling, adjustable-speed drives comes in ratings from 5 to 100 hp. Each drive of the Kinatrol line is offered as a complete package, including drive unit, control enclosure and operator's control station.

Ratings through 20 hp. are capable of continuous operation down to 100 rpm. at rated torque, providing a speed range of about 17:1. Through automatic control, regulation of 2% of full speed is standard for a typical friction-type load.

Coupling design features a new bearing arrangement that

assures positive gap alignment in service, and greatly simplified disassembly and reassembly. Windings are epoxy encapsulated.—**General Electric Co., Erie, Pa.** 172A



Conveyor Belt

Runs on 45-deg. idlers. High capacity, low cost.

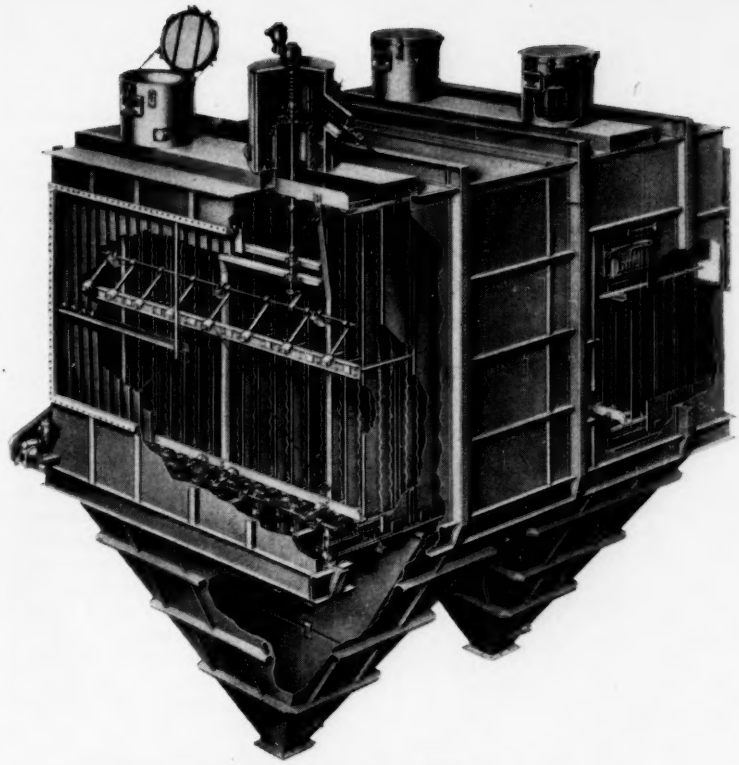
According to the manufacturer, the new Ray-Man conveyor belt makes it possible to successfully use and obtain the benefits of 45-deg. troughing idlers for carrying all materials. Conventional belts are usually confined to 20-deg. idlers.

Initial cost is lower, says the manufacturer, because narrower belts and conveyor equipment will haul the same loads as belts on 20-deg. idlers. Maintenance costs are lower because there is less spillage. Lower belt wear keeps the cost of belt replacement down. And, the manufacturer guarantees against ply or cover separation at the idler hinge line—good for the life of the belts—when they are used with troughing idlers set at any angle up to 45 deg.—**Raybestos-Manhattan, Passaic, N. J.** 173A

Reciprocating Pump

Attacked only by molten alkalis and fluorides.

Known as the Neumo 7010, a new, double-acting, reciprocating pump presents an unbroken face of Fluon (polytetrafluoro-



DECADE
OF OPERATION PROVES MAINTENANCE OF BUELL 'SF' PRECIPITATORS AVERAGE LESS THAN 2%

In 10 years of selling 'SF' electric precipitators, the number of replacement parts ordered from Buell has amounted to only 1.17% of the total sales! Even on emitting electrodes, usually the most vulnerable part of a precipitator, replacement has amounted to less than 1% of the original number installed. What do these extremely low percentages mean? Exceptionally low maintenance costs, for one thing, continuous high-efficiency operation, fewer shutdowns and process interruptions. Buell self-tensioned emitting Spiralectrodes eliminate vibration found in weight-tensioned wires. Buell's low maintenance precipitators will provide you with the most satisfactory operating results. They're backed by 25 years of experience in dust collection, with the practical know-how gained on hundreds of installations. Write for descriptive literature. The Buell Engineering Co., Inc., Dept. 12-B, 123 William St., N. Y. 38, N. Y. (Subsidiary: Ambuco Ltd, London, England)

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EXPERTS AT DELIVERING EXTRA EFFICIENCY IN DUST RECOVERY SYSTEMS

Atlas

INSTALLATIONS PROVIDE PERMANENT CORROSION PROTECTION!

tanks

Pickling, plating, chemical processing and storage tanks of all kinds, utilizing corrosion-proof linings and cements, are designed and constructed by Atlas to completely resist all types of corrosives.

floors

Atlas industrial floors for chemical processing areas, pickling and plating rooms form a corrosion-proof base against attack by alkalies, acids, solvents and salts.

hoods, ducts, fume systems

Rigid plastic structures, designed and fabricated by Atlas from polyvinyl chloride, exhaust all types of corrosive fumes. Plastic tanks and piping systems contain and convey corrosive solutions. All are completely corrosion-resistant throughout.

These Atlas installations will permanently protect your plant from corrosion. Write for Bulletin CC-3.

ATLAS MINERAL
MERTZTOWN, PENNSYLVANIA

ethylene) to liquid chemicals being handled. Coil springs, valve body, disk valves, plunger push-rod assembly, seals and coil springs are made of this resins.

Design ratings are 40 psi. delivery pressure and 150 double strokes/min., giving a maximum capacity of 72 gph. on low-viscosity fluids.—**Neumo Ltd., Peacehaven, Sussex, Eng.** 173B

BRIEFS

Flow switch that mounts directly in piping withstands working pressures to 2,000 psi. Vane-operated and magnetically actuated, each switch adapts to all pipe sizes; the vane responds to as little as 0.5 oz. force. Many materials of construction.—**W. E. Anderson, Inc., Kansas City, Mo.** 174A

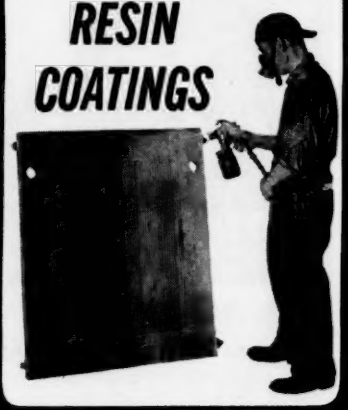
Extruded rods made of Delrin acetal resin are currently available in sizes to 3 in. dia. Each rod has a hard, glossy surface with low coefficient of friction. They also possess exceptional dimensional stability, good abrasion resistance and high fatigue endurance limit. Easily machined. —**The Garlock Packing Co., Palmyra, N. Y.** 174B

Single control valve for directing flow of liquids in Zeolite softeners, ion exchange units and filters will perform the functions of a nest of individual valves, while providing greater ease in operation and maintenance. Offered in cast iron or acrylic plastic for corrosive service, the valves can be operated manually or automatically. All moving parts remove readily for inspection and service.—**Graver Water Conditioning Co., New York, N. Y.** 174C

Temperature monitor for detection of part failures on a variety of motors and moving machinery uses a 92-channel system that scans, records and monitors temperatures through a 100-300 F. range. Scanning rate is 1 channel/min. Temperatures of parts

INCREASE the LIFE of Wood Filter Plates & Frames

SHRIVER RESIN COATINGS



Wood plates and frames coated with epoxy or urethane resin have shown amazing resistance not only to most corrosive chemicals, but also to heat.

Resultant increased service life more than pays for the moderate additional cost.

DISTINCT ADVANTAGES

1—Coating forms a hard, dense, adhesive, glossy surface, highly resistant to acids, alkalies and salts.

2—Reduces swelling, checking and distortion, so common with unprotected wood.

3—Improves durability in storage.

4—Offers excellent filter cake release.

5—Two coats, sprayed on, assure uniform penetration and covering of ALL surfaces.

6—Multiplies service life of plates and frames.

Let us prove these claims.

T. SHRIVER & CO., Inc.
802 Hamilton St., Harrison, N. J.
Sales representatives in
Atlanta, Buffalo, Chicago, Detroit,
Houston, Los Angeles, St Louis San Francisco,
Montreal, Toronto, Mexico City

being tested are picked up by copper-constantan thermocouples. Appropriate alarm signals are provided.—**Gilmore Industries, Inc., Cleveland, Ohio.** 174D

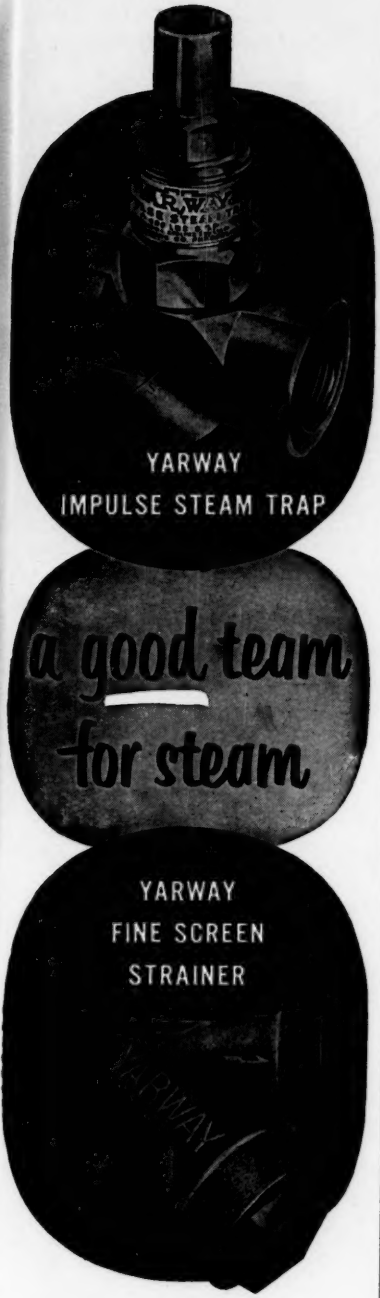
Incandescent lamp of microminiature design is offered for application in electronic systems. Small enough to pass through the eye of a needle, the unit's light output is in the order of 100 millilumens at 1.5 v. input. Efficiency is about 1.5 lumens/w. Typical application is as part of a computer readout display.—**Sylvania Electric Products, Inc., New York, N. Y.** 175A

Rotary air-lock feeder for handling free-flowing cubes, pellets, chips, flakes, etc. will not crush or grind friable materials, according to the manufacturer. All units come with packing gland seals and outboard antifriction bearings. Offered in a wide variety of sizes, and in two models, the feeders are constructed of stainless and carbon steels, Inconel, Monel or nickel.—**The Young Machinery Co., Inc., Muncy, Pa.** 175B

Equipment Cost Indexes . . .

	Sept. 1959	Dec. 1959
Industry		
Avg. of all	235.8	237.0
Process Industries		
Cement mfg.	229.9	231.1
Chemical	237.5	239.0
Clay products	223.4	224.6
Glass mfg.	224.2	225.6
Paint mfg.	228.0	228.7
Paper mfg.	228.8	230.2
Petroleum ind.	232.9	233.6
Rubber ind.	235.7	236.5
Process ind. avg.	234.1	235.4
Related Industries		
Elec. power equip.	239.4	242.1
Mining, milling	239.0	240.4
Refrigerating	266.4	267.3
Steam power	223.2	223.9

Compiled quarterly by Marshall and Stevens, Inc. of Ill., Chicago for 47 different industries. See Chem. Eng., Nov. 1947, pp. 124–6 for method of obtaining index numbers; Feb. 23, 1959, pp. 149-50 for annual averages since 1913.



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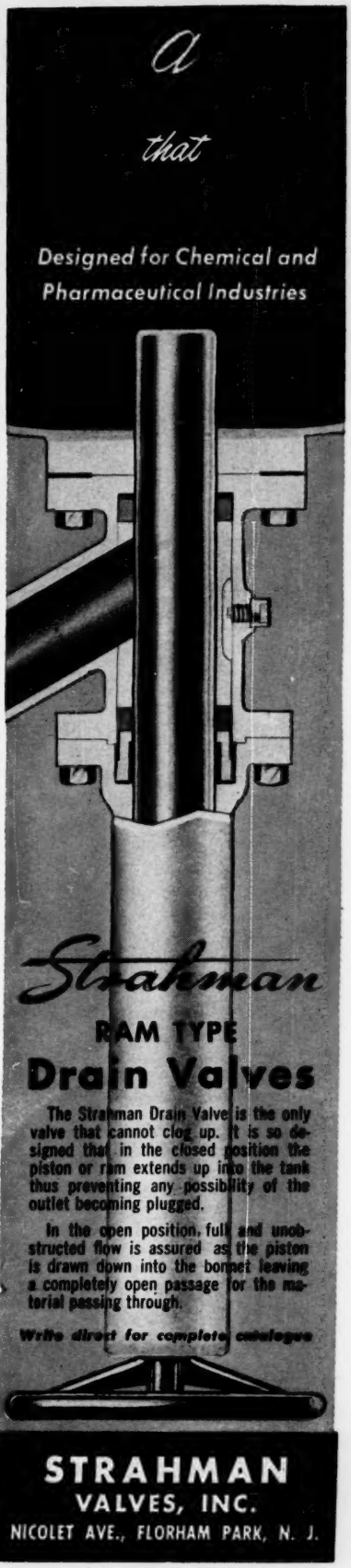
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The Strahman Drain Valve is the only valve that cannot clog up. It is so designed that in the closed position the piston or ram extends up into the tank thus preventing any possibility of the outlet becoming plugged.
In the open position, full and unobstructed flow is assured as the piston is drawn down into the bonnet leaving a completely open passage for the material passing through.
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FOR Inherent Accuracy–Power–Speed and Stability

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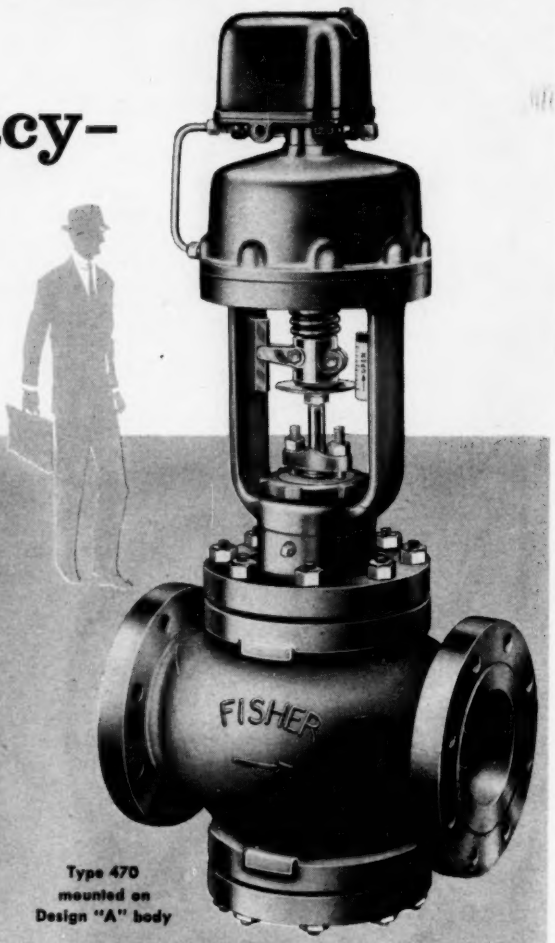


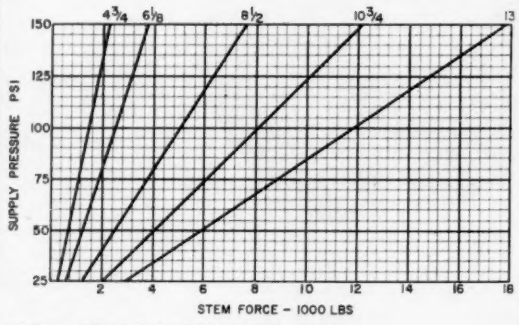
Type 470 mounted on Design "A" body

- **Delivers same power in either direction at any point of the stroke.**
- **Adaptable to virtually all types of valve bodies including Butterfly valves.**
- **No air set required—utilizes clean, non-corrosive air or gas up to 150 psi.**
- **Easily reversible actuator can be changed in the field.**

This small, compact piston actuator incorporates its own positioner mounted integrally on top of the cylinder. Positioner receives any of the normally used pneumatic instrument signals. Then, without an air set, actuator utilizes the full potential of the available instrument or gas supply to provide exceptional speed and power. Series 470 in available in six basic sizes and can be supplied for travel up to 4". Basic actuator can also be furnished with a handjack, hydraulic snubber, pneumatic safety devices or as a spring return unit. Write for Bulletin E-470.

PERFORMANCE DATA

Air Consumption (Static)	20 SCFH at 100 psi supply.
Instrument Signals	3 to 15 psi, 5 to 25 psi, 6 to 30 psi, 12 to 60 psi. Suitable for split range also.
Temperature Limitation	175°F.
Maximum Hysteresis	15% of total stroke or instrument signal.
Repeatability	.03% of the total stroke or instrument signal.
Resolution Sensitivity	Minimum change in the measured variable to produce an effective movement of the final control element is .02% of the instrument pressure range.
Frequency Response	1.4 cps for the Size 60. 4 cps for the Size 30.
Load Sensitivity	Percent of total travel per 100 lbs. stem force is .065% for Size 60.



CYLINDER DIAMETERS AS MARKED ON EACH CURVE.

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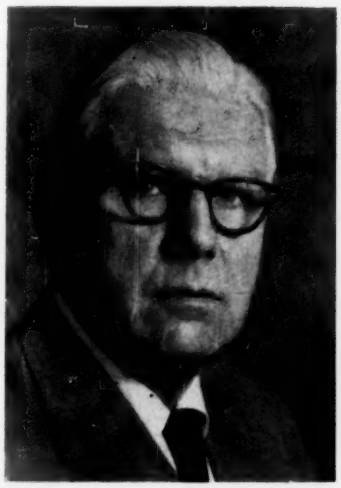
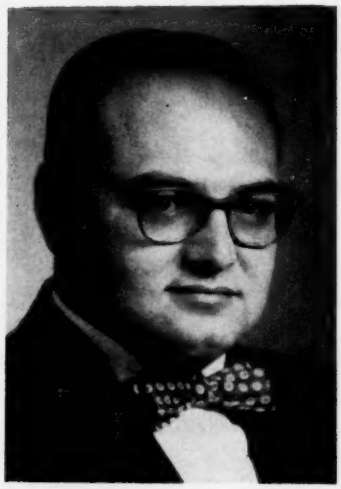


Herman F. Mark



Norman G. Gaylord

Toward a Clearer Understanding

LINEAR AND STEREOREGULAR ADDITION POLYMERS: POLYMERIZATION WITH CONTROLLED PROPAGATION. By Norman G. Gaylord and Herman F. Mark. Interscience Publishers, Inc., New York. 571 pages. $17.50.

Reviewed by Joseph J. Smith, Union Carbide Plastics Co., Bound Brook, N. J.

Catalysts and processes which yield linear and stereoregular polyolefins, and other vinyl compounds, continue to have far-reaching impact on the synthetic rubber, fiber and plastics industry. More and more chemists, physicists and engineers will be engaged in this field as it expands in the near future.

This book will be valuable both to the newcomer in the field and to the experienced worker.

For the uninitiated, Gaylord and Mark have provided an excellent text for learning the related essentials. Early chapters clearly review addition polymerization kinetics, adsorption on surfaces, complex formation and pertinent stereochemical principles. With this background, the neophyte can better explore the mass of information in subsequent chapters dealing largely with reported lab studies on catalysts, polymerizations and polymers.

For chemists and engineers experienced in the field, the authors have commendably reviewed the extensive material in foreign patents, published articles and unpublished papers.

Unfortunately, it is practically impossible at this time for the completely objective author to give us an integrated picture of the essential catalytic and polymerization processes. This is because it's not easy to distinguish definitive reports in the literature from those fairly numerous ones in which results are meager, misleading or improperly interpreted.

It's to be hoped that the authors can give us subsequent

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These Bulletins will help you solve your compressed air and liquid filtration problems.

For more than twenty years, the R. P. Adams Co. has worked with engineers to improve compressed air and simplify liquid filtration. The following literature reflects this wide experience — why not take advantage of this know how — write for your copies today?

Air and Gas Aftercoolers and Cyclone Separators

... provide effective low cost moisture removal from compressed air and gasses. Wet compressed gasses must be freed of damaging moisture before they can be safely used in air operated tools, equipment and instruments or other applications. The counterflow, water-in-the-shell design affords highly efficient vapor condensation. Models are available for cooling the gas to within 10° or 2° of the cooling water — dependent upon the dryness required. The Cyclone Separator then effectively removes condensates over a wide range of flows. This combination assures you of moisture free — trouble free compressed air and gas with less than ½ P.S.I. pressure loss. Models are available from 60 - 44,000 CFM in working pressures up to 1000 P.S.I.

Write for ..... Bulletin 713

Poro-Stone Air Filters

... can eliminate tool malfunction, instrument failure and contaminated products caused by foreign material in compressed air or gasses. Centrifugal separation and efficient Poro-Stone filtration combine to remove all pipe scale, dirt, and entrained oil and water with less than ½ P.S.I. pressure loss — ranges from ⅜" to 4" pipe size, from 15-700 CFM. Models in 150, 300 and 500 P.S.I. Get the complete facts on how to protect your compressed air system and related equipment.

Ask for ..... Bulletin 117

Adams Chemical Filters

... provide an effective method of solids removal. Completely enclosed construction coupled with dynamic back wash design provides contamination free — low cost separation. The availability of a variety of filter media meets the needs of any process. A wide selection of materials of construction—including lead and rubber linings—models in jacketed construction—can be supplied in various sizes and capacities. Investigate the many benefits of the Adams Chemical Filters.

Write for ..... Bulletin 431

Adams Industrial Filters

... are ideal for the filtration of process liquid and gasses as well as polishing industrial water and waste. An assortment of filter elements to provide efficient filtration for virtually every industrial application are available. Sizes are made to suit any process requirement. For complete details of how Adams filters can reduce your processing costs, write for ..... Bulletin 651

Where automatic water filtration is required, request ..... Bulletin 909

R & D — Pilot Plant Filters

... are available as self contained filter packages—including pre-coat equipment. The JWF-28, completely assembled and mounted on a skid, is available for pilot, research and development or for small process applications involving flows up to 80 GPM. You make only three connections. For complete information, write for ..... Bulletin 610

R. P. Adams Co., Inc., 207 East Park Drive, Buffalo 17, New York.

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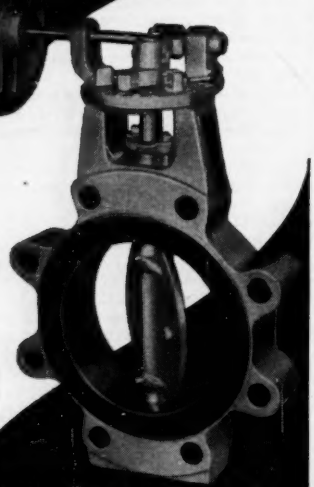

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VALVES

ENGINEERING FACTS

For control of air, gases or process fluids Rockwell Wafer Butterfly Valves give you these installation, service and maintenance advantages not found in other types:

1—Narrower body, less length and simpler construction—make valve lighter, easier to install in less space at lower overall cost.

2—Equalized pressure on valve disc makes opening and closing simple. Minimum pressure drop.

3—Rubber, Neoprene, Hycar, Viton or other resilient synthetic seat forms positive drop-tight seal on shut off and a tight gasket seal between valve and pipe flanges. The "Keelok" seat is easily removable.

4—No fouling—no clogging—valve is self-cleaning.

5—Valve may be operated manually or by automatic remote control. Sizes—from 2" to 48".

Write for Bulletin 583.

W. S. ROCKWELL COMPANY
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editions and an even clearer view of the fundamentals sought in current research studies here and abroad.

BRIEFLY NOTED

INDEX OF ABBREVIATED AND FULL TITLES OF SCIENTIFIC AND TECHNICAL PERIODICAL LITERATURE. 237 *pp. Publishing House of the USSR Academy of Sciences*, 1957. *Office of Technical Services, U. S. Department of Commerce, Washington* 25, *D. C.* $4. Lists all publications processed in abstract journals of Institute for Scientific Information.

MINERALS YEARBOOK. *Bureau of Mines. Three volumes.* 2,779 *pp. Superintendent of Documents, Government Printing Office, Washington* 25, *D. C. Vol. I—Metals and Minerals:* $4; *Vol. II—Fuels:* $2.25; *Vol. III—Area Reports:* $3.75. Comprehensive record of activities and developments in the nation's mineral industry's during 1958.

PATENTS AND INVENTIONS—AN INFORMATION AID FOR INVENTORS. 25 *pp. Superintendent of Documents, U.S. Government Printing Office, Washington* 25, *D. C.* 15¢. Offers information on patenting and patent procedures, developing and marketing inventions.

STANDARDS ON METAL POWDERS AND METAL POWDER PRODUCTS. 96 *pp. American Society for Testing Materials*, 1916 *Race Street, Philadelphia* 3, *Pa.* $2.25. Standards cover metal powders, bearings, structural parts, carbides, heavy metals and terminology of powder metallurgy.

MORE NEW BOOKS

SYNTHESIS AND ORGANISATION IN THE BACTERIAL CELL. By Ernest F. Gale. Wiley. $3.50.

INDUSTRIAL COMPLEX ANALYSIS AND REGIONAL DEVELOPMENT. By Walter Isard, Eugene W. Schooler and Thomas Vietorisz. Technology Press and Wiley. $8.75.

ORGANIC CHEMISTRY. By Donald J. Cram and George S. Hammond. McGraw-Hill. $8.50.

ORGANIC REACTIONS, Vol. 10. Edited by Roger Adams. Wiley. $10.

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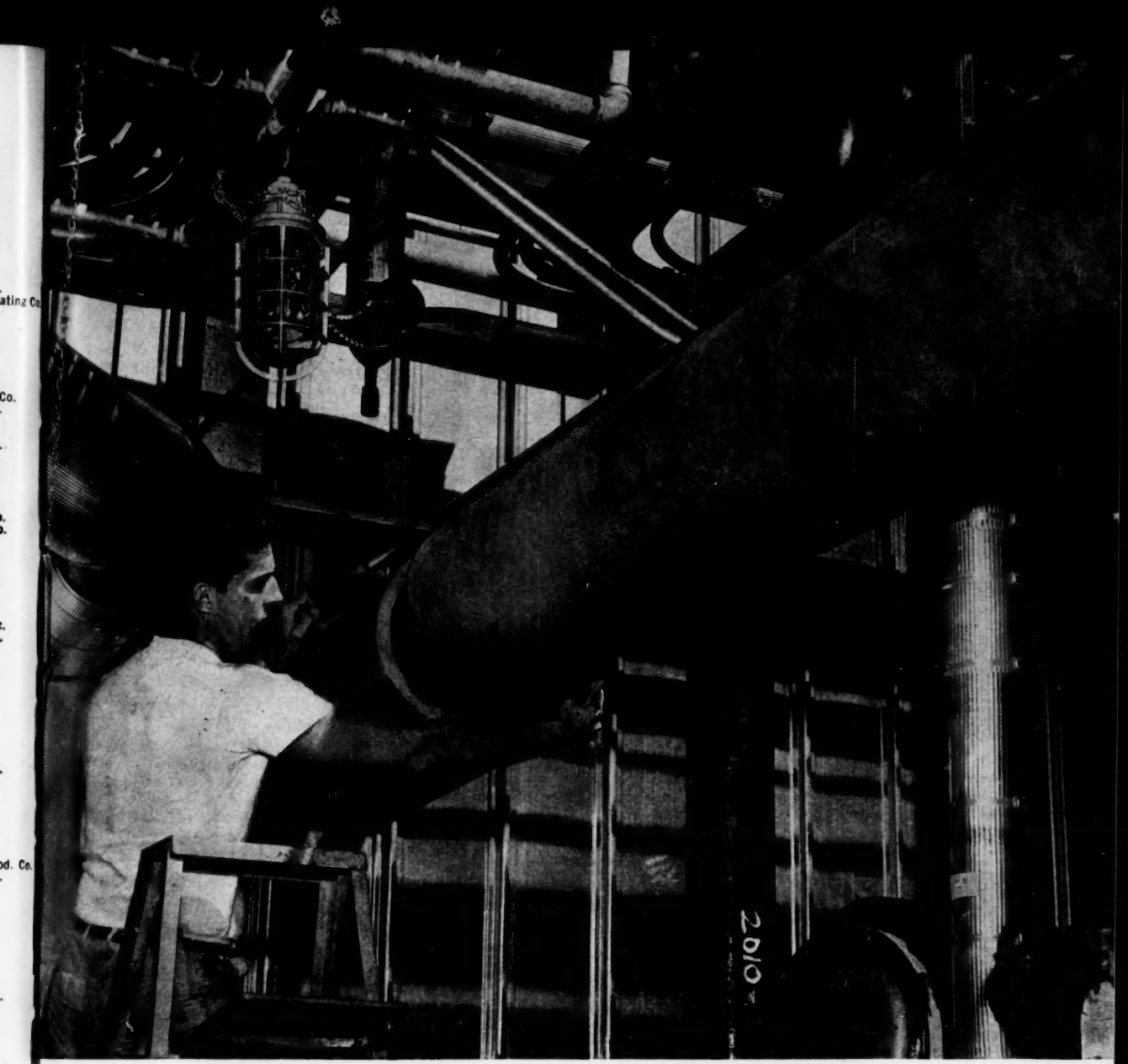

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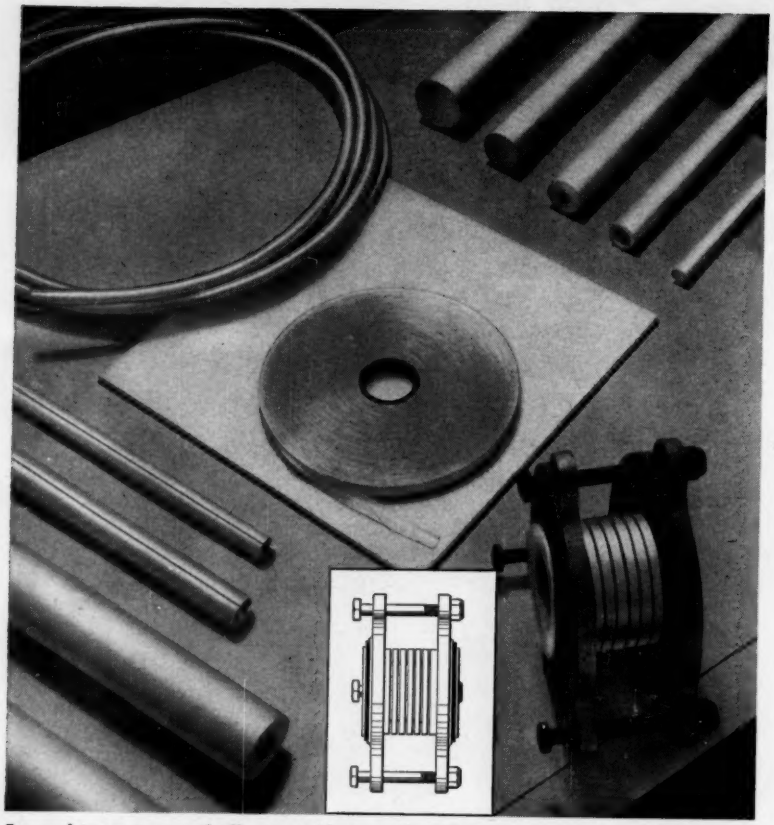

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LETTERS:

Compromise With Flesch

Sir:

During the controversy over Dr. Flesch's ideas on simplified writing, you could have found a middle course to follow and recommend.

The Flesch idea of short words and complete simplification removes all the excitement from writing. It eliminates precise meanings and nuances of meaning. The opposed school of what Flesch calls pompous words and phrases is equally undesirable for technical writing.

All technical articles and books should be edited and shortened by the editors, and the authors ought not to resent such changes.

E. A. GODAT

Monterrey, Mexico

▶ *The "middle course" which we recommend for most technical writing is the style we aim for in our own editorial columns—neither too breezy nor too stilted. We're not always precisely on the beam, but we try to avoid both extremes.*—ED.

Con: Personnel Engineer

Sir:

I hope you had tongue in cheek when you published that amusing article on the "personnel engineer" (Oct. 19, pp. 210-216). Next we will expect to see you publish similar job descriptions on File Engineers (those who file engineering information) and on Stenographic Engineers (those who type engineering information)!

The disturbing thing about this article is not that *CE* would waste its readers' time with it, or even that these psychological witch doctors would presume to include themselves in the engineering profession.

What really rankles is the realization that General Dynamics, an organization that would fold tomorrow without its engineers, thinks so poorly of them as professionals that it has such a job title as "Personnel Engineer." Apparently the word "en-

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C. H. CHILTON

gineer" in General Dynamics means very little.

JACK HOPPER
Process Sales Co.
Houston, Tex.

Sir:

I was very surprised that such a staunch supporter of the title of "engineer" for engineers would accept an article like the one by Mr. Obrochta on "personnel engineering."

It seems as though *Chemical Engineering* has an obligation to its readers to set a higher premium on the term "engineer," especially when Engineers Joint Council and the various societies have gone to considerable effort to combat loose usage of the term.

I can understand why Mr. Obrochta wrote this article. As per an earlier article from Convair ("How We Encourage Engineers to Write," Oct. 5, p. 162-166), the Convair people pay their employees $150 for each article printed.

But I can't understand why you printed it. Was it just to see what reactions you would get?

JOHN J. MCKETTA
University of Texas
Austin, Tex.

Con: Unionization

Sir:

Congratulations to Mr. Lilly (Sept. 21, p. 210) on his views regarding unionization of engineers.

Like you, I do not agree with him on the point that professional societies and publications should take sides in this issue. However, I believe he has done an excellent job of evaluating the situation, and I sincerely hope that the majority of engineers will see through the pseudo-advantages offered by unionism and cast their ballots for professionalism.

CARLOS A. DUHARTE-FRANCIA
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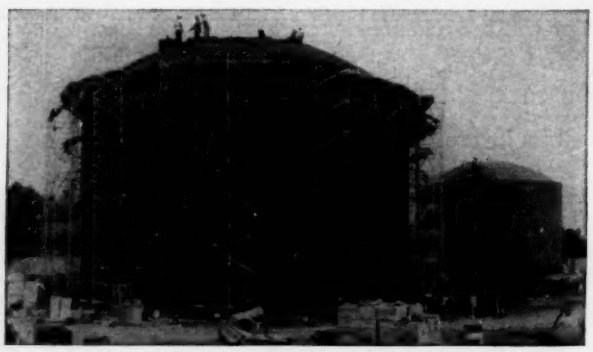

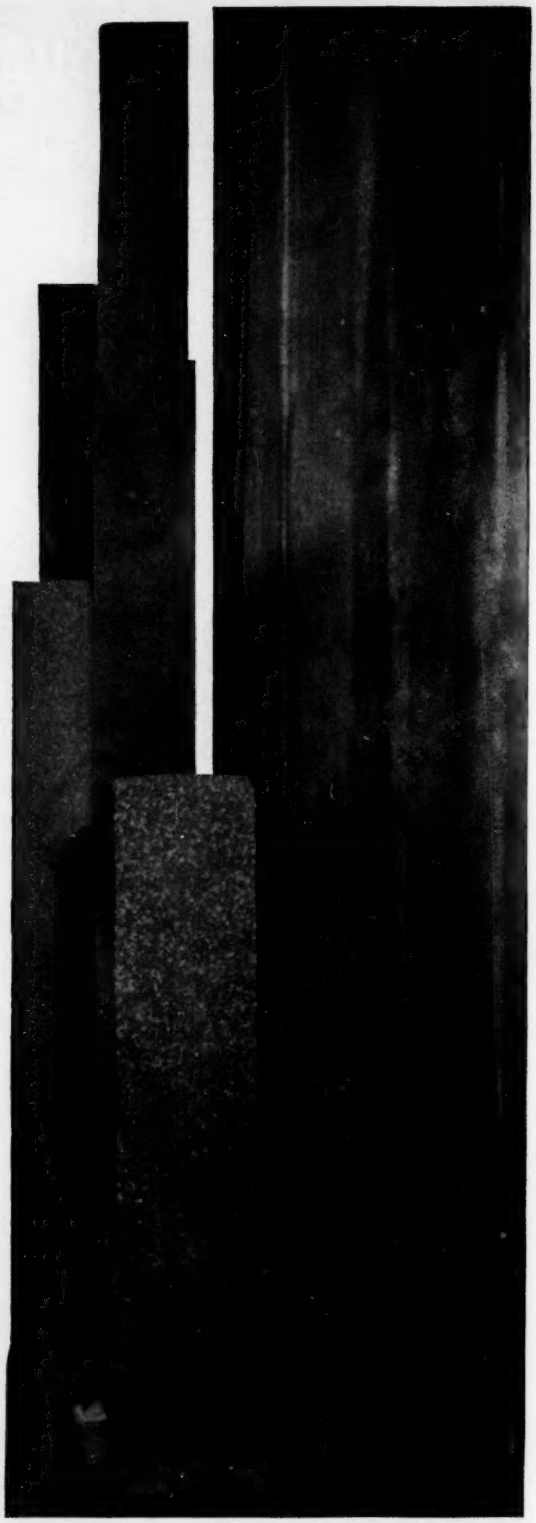

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Heat Exchanger Calculations—12 part-series ($1)..... 136
Instruments—"Hardware" section of Report 95 (50¢).... 96
Mechanical Seals—How to select and use them (50¢).... 83
Piping—Roundup of process pipe, valves, fittings (75¢).. 40
Pumps—How to pick the one you need for your job (50¢) 21
Pump Seals—How to select the best (50¢)..... 92
Solids Feeders—How to lick feeding troubles (50¢)..... 28

• Processes

Adsorption—Design, methods, materials (50¢)..... 154
Biochemicals Processing—The total picture (50¢)..... 93
Bio-oxidation—Theory, design, practice (50¢)..... 68
Chemicals From Petroleum—Available processes ($1).... 139
Extractive Metallurgy—Via chemical engineering (50¢).. 111
Extremely Low Temperatures—Production and uses (50¢) 133
Fermentation—Its chemical technology (50¢)..... 74
Manufactured Gas—To supplement natural gas (50¢)... 115
Moving Bed Processes—Application plus theory (75¢)... 64
Odor Control—How to be a good neighbor (50¢)..... 98
Process Energy—Make or buy? (50¢)..... 142

• Costs and Other Timely Topics

Air Pollution—How to cope with problems (50¢)..... 143
CE Cost File—Quick estimating data (50¢)..... 153
Cost Control Systems—How to build your own (50¢).... 102
Cost Estimation-III—17 articles, 80 pages ($1.25)..... 48
Cost Index—One-year bibliographic index (35¢)..... 65
Engineering with Models—Scale & test models (50¢).. 53
Flowsheets—How to speed communications (50¢)..... 99
Flow File—50 formulas (50¢)..... 112
Inflation—How to predict the shrinking dollar (50¢).... 78
Liquefied Compressed Gases—How to handle (50¢)..... 147
Lubrication—For chemical plant engineers (50¢)..... 50
Modernization—Plan '59 for profits (75¢)..... 128
Nuclear Industry—The role of chemical engineers (50¢).. 89
Nuclear Wastes—Treatment and Disposal (50¢)..... 150
Operation & Maintenance—The impact of trends ($1).... 121
Patent Fundamental—Timely review (50¢)..... 114
Photochemical Engineering—Uses, processes, reactors (75¢) 59
Pilot Plants—All the aspects of scale-up ($1)..... 127
Plants & Processes—Inventory of 1955 (75¢)..... 69
Plants & Processes—Inventory of 1956 (75¢)..... 84
Processes & Technology—Eighth Inventory 1958 (50¢).. 118
Professional Registration—For PE-minded ChE's (50¢)... 85
Rockets & Missiles—Airborne reactor problems (75¢).... 119
Safe Handling of "Reactive" Chemicals (50¢)..... 134
60's Challenge Chemical Engineers (50¢)..... 152
Speculative Process Design—Pilot plant bypass (50¢).... 146
Statistics—How to use data effectively (75¢)..... 73
10 Top Chemicals—Current trends (50¢)..... 132
Water Conservation—A factor to consider (50¢)..... 105
Water Pollution Control—To cope with problems (50¢).. 122

• Unit Operations

Binary Distillation—Theory, equipment (75¢)..... 54
Compressible Fluids—How to handle ($1)..... 80
Crystallization—For purification (50¢)..... 124
Drying—Methods, equipment, design, costs (75¢)..... 70
Entrainment Separation—Equipment & Performance (75¢) 37
Foams—How to use and how to control foams (50¢)..... 86
Gas Purification—Today's processes ($1)..... 140
High Temperature Technology—Materials, processes (50¢) 91
Ion Exchange—A chronicle of remarkable advances (75¢) 55
Liquid-Gas Contacting—A practical operation study (75¢) 82
Liquid Proportioning—Equipment, methods, uses (50¢).. 76
Process Control—Up-to-date instrumentation report ($1).. 95
Size Reduction—Major pieces of equipment (50¢)..... 25
Solids Concentration—Survey of techniques (50¢)..... 67
Solids-Gas Contacting—Integrated background (50¢).... 63
Solids-Liquid Separation—Basic know-how ($1)..... 62

New and Popular Series . . .

Estimating Engineering Properties. By Wallace R. Gambill.
- Thermal Conductivity (50¢).. 94
- Heat Capacities (75¢)..... 109
- Latent Heat (75¢)..... 117
- Surface Tension (75¢)..... 126
- Viscosity (75¢) 138
- Critical Properties (75¢)..... 149
- Other Physical Properties (50¢) 151

CE REFRESHER
- Thermodynamic Principles (50¢) 42
- Compression & Expansion (50¢) 45
- Chemical Equilibrium (50¢)... 49
- Homogenous Kinetics (50¢)... 57
- Catalytic Kinetics (50¢)..... 61
- Interpreting Kinetics (50¢)... 66
- Simple Reactor Design (50¢).. 72
- Complex Reactor Design (50¢). 75
- Catalytic Reactor Design (50¢). 81
- Reactor Design Problems (50¢) 87
- Physical Equilibrium I (50¢)... 90
- Physical Equlibrium II (50¢).. 97
- Fluid Flow Equations (50¢)...101
- Fundamental Math (75¢)....113
- Mass Transfer Operations ($1).130

Unit Operations Refresher
- Fluid Flow (50¢).....144
- Sedimentation Theory (50¢)...148

Flow Through Packing and Beds. By Max Leva.
- Packed Towers (50¢)..... 103
- Fixed and Moving Beds (50¢) 107
- Fluidized Systems (50¢)..... 108

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- Parts I-V (75¢)..... 100
- Parts VI-IX (75¢)..... 110

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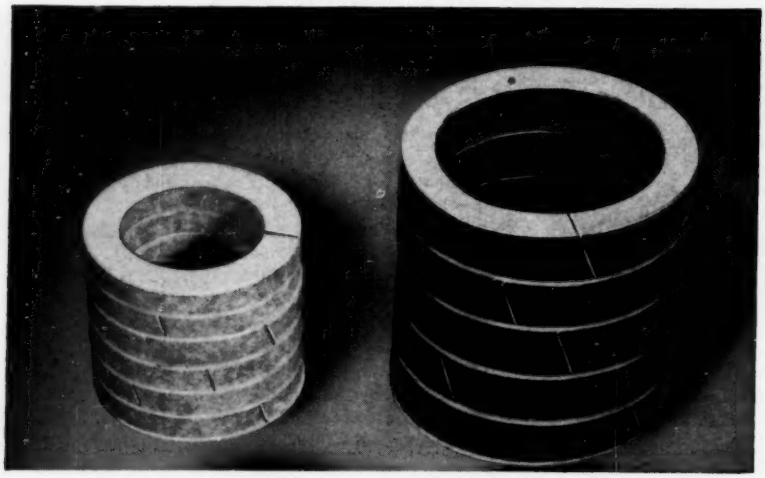

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These two stuffing box packings drastically cut packing replacement and maintenance costs. Styles 101 and 201 last for months under corrosive conditions where ordinary packings fail in days and even hours. Successfully seals against bromine, chlorine, butyl extracts, sulphur dioxides, concentrated sulphuric acid, aqua regia, thionyl chloride and organic solvents including halogenated hydrocarbons, etc.

Ideal for use on either centrifugal or reciprocating pumps, at speeds up to 3600 R.P.M. and at temperatures ranging from —118°F. to +525°F.

STYLE No. 101 — Compounded of approximately 94% shredded Teflon and a graphite friction reducer, molded into packing rings.

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5 Broadway, New York 4, N. Y.

The Original Fabricators of Teflon Packings and Gaskets

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TECHNICAL

Contents of This Issue

Chemicals	186
Construction material	190
Electrical & mechanical	192
Handling & packaging	194
Heating & cooling	196
Instruments & controls	200
Pipe, fitting, valves	202
Process Equipment	206
Pumps, fans, compressors	210
Services & miscellaneous	211

Chemicals

Alloys.....A copy of 104-page booklet covers alloys, their properties, forms, the corrosives they will resist, etc. Available now on your request.
155 *Haynes Stellite Co.

Caustic Potash.....available in 6 forms. New technical Bulletin 15 is crammed with facts, tables, diagrams for applying caustic potash.
79 *Allied Chem., Solvay Process Div.

Chemical Cleaners.....18 p. bulletin No. 102 discusses power plant, stainless steel, aluminum metal & alloy and general chemical cleaning. Also covers bottle washing
186A Chas. Pfizer

Chemicals.....Company can now provide toxicity data on nine development chemicals including pyrrole, N-methyl pyrrole, N-hydroxy ethyl pyrrolidine, N-butylene pyrrolidine.
186B Ansul Chemical Co.

Chemicals.....A list of patents that are available on the use Hydrogen Peroxide, Peroxygen Chemicals and Persulfate Chemicals is yours for the asking.
51a *Becco Chemical Div., FMC

Chemicals.....36 p. catalog & directory reviews company's products in basic chemicals, monomers, polymers, resins, adhesives, coatings, plastic products.
186C Borden Chemical Co.

Chemicals.....A 16-page booklet lists the many chemicals available, such as; vinyl stabilizers, fluorides, glycerine, synthetic optical crystals, fungicides, etc.
20 *The Harshaw Chemical Co.

Diatomite.....Every grade of Celite offers constant uniformity. Assistance with specific filtration or mineral filler problems is available on request.
224 *Johns-Manville

* From advertisement, this issue

LITERATURE

E. M. FLYNN

Epoxy Laminates.....Two 1 p. bulletins, Nos. 607AA & 606 describe two improved non-irritant epoxy laminating systems now being made commercially available.
187A Marblette Corp.

Fatty Acids.....22 p. "Fatty Acids from Tall Oil" discusses supply factors, describes, properties, use in protective coatings, core oils, flotation, cleaners.
187B Hercules Powder Co.

Filter Aids.....2 p. sheet titled "Facts on Filteraids & Fillers" describes diatomite and perlite fillers & filteraids, carbon-based filteraids. Send for your copy.
187C Great Lakes Carbon

Fluorocarbons.....4 p. bulletin, "Blowing Foams with Isotron," discusses recent developments in urethane foam making technique by blowing with fluorocarbons.
187D Pennsalt Chemicals Corp.

Hydrogen Peroxide.....63 p. bulletin conveys properties, handling, dilution and storage. Contains numerous charts, graphs and tables on physical properties.
187E Allied Chemical

Hydroxyethyl Cellulose.....16 p. booklet describes properties and uses, contains data on preparation of solutions, film & coating properties, shipping data.
187F Union Carbide Chemicals.

Mineral Acids.....Complete information on production, transportation, service & sales facilities geared to meet your requirements is available on request.
59 *Allied Chem., Gen. Chem. Div.

Molten Sulphur.....Detailed instruction sheets & drawings are available on request for those interested in proper facilities for handling & storing molten sulphur.
41 *Texas Gulf Sulphur Co.

Molybdenum.....12 p. brochure lists forms of molybdenum available commercially and explores the many new avenues of application opened by technical advances.
187G Sylvania Electric Products

* From advertisement, this issue

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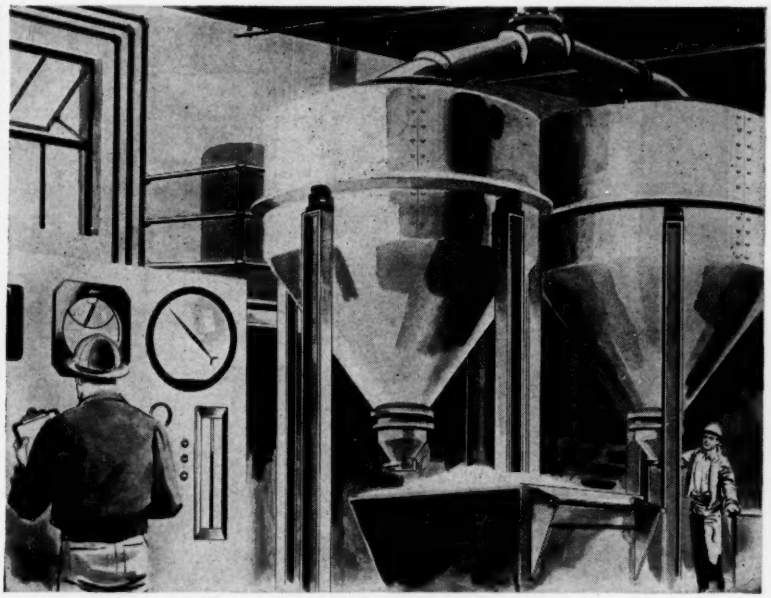


Explosion-Proof Equipment Provides Control For Hopper-Filling Mechanism

A pharmaceutical manufacturer wanted to weigh powdered ascorbic acid as part of its process in making Vitamin C tablets. The powder is gathered in hoppers which weigh 3500 pounds and handle a maximum net load of 8750 pounds.

The conditions demanded that the equipment be explosion-proof and that the weighing signal be used to actuate automatically a diverting gate in the filling system which would switch the in-flow from one hopper to another.

An Emery Engineered Weighing System, based on the use of 4 Model EC-30 load cells and a hydraulic totalizer and using a 16" Emery Precision Indicator together with a Foxboro controller, handled the hopper-weighing job with an accuracy of ¼% of full range. Customer satisfaction is guaranteed.

If you have a tank, bin or hopper weighing problem which involves a control function, write today. Our literature is graphic, descriptive and easy to use in figuring a system for your installation. The A. H. Emery Company, Pine Street, New Canaan, Conn.

EMERY

SARCO TOPICS

HOW TO SOLVE COMMON TRACER LINE PROBLEMS

How to cure water hammer with a steam trap that will operate in vertical position

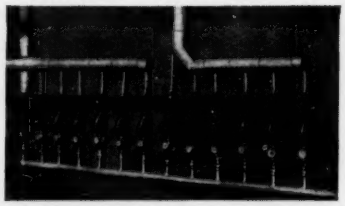
Water hammer is an inherent problem in long tracer lines. So is freezing. Both problems can be overcome, and here's an example of how it has been done. At the Socony Mobil Oil Company's Paulsboro, N. J., refinery, they found that the Sarco Thermo-Dynamic Steam Trap, type TD-50, not only withstands water hammer, but installing the trap in a vertical position —which permits free drainage—presents no problems at all, thanks to its unique thermodynamic principle. In fact, 90% of the 250 TD-50's at this plant are vertically mounted. They never block heat transfer, and they remove condensate and air as fast as they collect.

How to handle varied steam pressures — without adjustment

Can a trap — without adjustment — handle steam pressures that vary from 15 to 160 psi? Can the *same* trap vent air and drain condensate as rapidly as it is formed, be easy to install and require practically no maintenance at all? That was the problem set up by the engineering staff of Armour Chemical Division's McCook plant. They solved it by testing many traps. Their conclusion: Sarco TD-50 steam traps meet or beat their specifications, because:
they discharged condensate as fast as it formed, without wasting steam;
their compact inline construction made installation easy, even in tight quarters;
maintenance was practically negligible;
no adjustment was necessary for varying steam pressures. (In fact, the TD-50 is self-adjusting through its full operating range of 10-600 psi.)

No other steam trap can so adequately solve all these problems at one time.

How to be certain process fluid stays above 280° F. in tracer lines when outside temperature drops to 10° F.



The problem of maintaining design temperatures on tracer lines need not be difficult, no matter how extreme the conditions seem to be. For example, the tracer lines in a phthalic anhydride process at Witco Chemical Company's new Chicago plant had to be maintained above 280° F. Below this temperature, the chemical sets and the whole system would have to be taken apart and re-assembled. That's not all; ambient temperatures sometimes could drop to −10° F.

With reliability as a prime consideration, Scientific Design Company, Inc., who designed and constructed this brand new plant, selected the TD-50.

Because the TD-50 can be mounted vertically, freezing was no problem either. Added benefits that matter on tracer lines: the TD-50 is compact, light in weight, easy to install.

What is the most reliable tracer line trapping method to prevent unscheduled shutdown?

Particularly in refineries, steam traps have to function under exactly the kind of conditions that you'd expect to cause failure—they must function equally satisfactorily on low pressure or exhaust steam and on up through high-pressure, high temperature ranges. Not only that, but outside temperature may vary from subzero to subtropical. If maintaining design temperatures in your tracer lines appears to be hampered by these problems, consider how Phillips Petroleum Company, Kansas City, solved them. They found a trap which drains their tracer lines automatically over a full range of pressure, temperatures and loads. It's the Sarco TD-50 Steam Trap.

With only one moving part—a stainless steel disc, the TD-50 has little that can go wrong. In fact, it's so free of trouble that Phillips Petroleum Company consider their TD-50's as reliable and efficient as the piping. They now rely on 1800 of them throughout the plant. 1408

FOR FULL INFORMATION ON TRACER LINE TRAPPING or on any steam trapping problem—see your Sarco Sales Representative or write to

SARCO COMPANY, INC.
635 Madison Avenue,
New York 22, N. Y.
Plant: Bethlehem, Pa.

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rt. 2. *Maintenance*—practically zero.
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pressures from 10 to 600 psi. 4. *Uni-*
m performance—operates equally
ll on heavy, light, or no condensate
d. 5. *Operates against back pres-*
es—up to 50% of inlet pressure.
Rugged—unaffected by superheat,
ter hammer, vibration, or corrosive
ndensate. 7. *Minimizes inventory* of
re parts.

intenance Time: 40 Seconds. If it now
es your maintenance crew more
n a couple of minutes to service an
linary trap, you're throwing away
luable time. This Sarco Thermo-
namic can be cleaned, blown out if
essary, and reassembled on the line
as little as 40 seconds.

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for fast help on the efficient solu-
n of any steam trapping problems,
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LITERATURE . . .

Pelletized Borohydrides.....for continuous fixed-bed, in stream carbonyl group & peroxide reductions. Sizes of pellets are 10/32" & 24/32" in diameter. Information.
205a *Metal Hydrides Inc.

Plastic Laminates.....Company's grade GEC-111 glass-base, epoxy-resin laminated plastic & grades GEC-111 E & GEC-111 R copper-clad laminates are covered in 2 2 h-p. bulletins.
189A Taylor Fibre Co.

Plasticizers.....8 p. bulletin describes highly stable polymeric plasticizer of moderate molecular weight called NP-10. Data show effect on PVC. Send for your copy.
189B Eastman Chemical Products

Plasticizers.....10 p. bulletin No. 20, "Ditridecyl & Didecyl Phthalates in High Temperature Vinyl Insulation," includes numerous tables of test results.
189C Enjay Co.

Plastics.....10 p. booklet uses caricature drawings to show superiority of company's thermosetting material, Fianite, as compared with thermoplastics for pump parts.
189D Deming Co.

Plastics.....16 p. booklet outlines properties, applications, availabilities of company's nylon, Teflon, and other new industrial plastics. Covers sintered parts.
189E Polmer Corp.

Plastics.....2 p. bulletin describes a new flame-retardant version of company's Grade X laminated plastic. Includes notes on typical applications in structural parts.
189F Taylor Fibre Co.

Polycarbonates.....12 p. brochure describes complete line of polycarbonate resins, phenolic resins, varnishes and molding powders and fused magnesium oxide.
189G General Electric

Sodium Borohydride.....Complete details concerning Sodium Borohydride SWS. the new stabilized water solution form that cuts the price of NaBH 4 more than in half.
205b *Metal Hydrides Inc.

Solvents.....2 p. bulletin, "Harco Cold Cleaning Solvents," cover products said to offer savings in material costs by meeting needs more specifically.
189H Harco Chemical Co.

Solvents.....Valuable reference lists 69 solvents, couplers, and diluents, as well as a number of plasticizers. It gives evaporation rates, viscosities, etc.
209 *Union Carbide Chem. Co.

Sulfuric Acid.....Three bulletins cover bulk handling & storage of sulfuric acid & oleum (I-182), chlorosulfonic acid (I-181) and muriatic acid (I-183).
189I Monsanto Chemical Co.

Synthetic Rubber.....Viton offers improved resistance to heat aging & fluid exposure. Tech. literature gives facts on Viton & how it can improve products you make & use.
89 *E. I. du Pont

Vinylpyrrolidone.....offers a new approach to a wide variety of polymeric products. Information on handling properties, copolymerization procedures, etc. in Bul. AP-86.
75 *Gen. Aniline, Antara Chem. Div.

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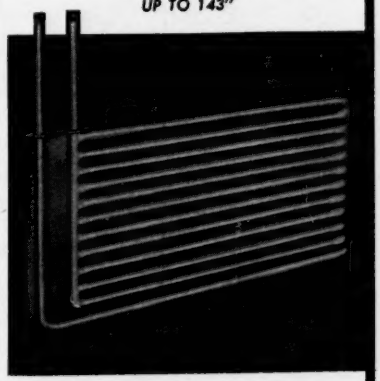

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59-4

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LITERATURE . . .

Construction Materials

Ceramic Catalyst Carriers.....are described in detail in the Bulletin, "Keys to Better Catalysis" which is now available on request.
49 *Norton Company Refractories Division

Coating.....The Kanigan process for chemical nickel alloy plating produces a uniform thickness of coating, regardless of the contours of a part. Bulletin 258.
201 *Gen. American Transportation

Coating....."D-A" will withstand temp. up to 600 F. Other Coatings available in a complete range of types for any condition & temp. up to 2200 F. Catalog No. MPC.
B202 *The Markal Co.

Coatings.....The broad Tygon line permits applications of specialized protection against a wide range of specific corrosives & exposure conditions. Bul. 760.
52 *U. S. Stoneware Co.

Extruded Shapes.....Bulletin gives information on steel and stainless steel extruded bars. Includes tolerances, design guide, specification chart and cost advantages.
190A H. M. Harper Co.

Fabricating.....Service, consultations and quotations on any type of plate and structural fabrication required in the chemical processing industry.
8-9 *Pittsburgh-Des Moines Steel Co.

Filteraid.....A new illustrated brochure covering the properties and characteristics of Nerofil, a new type of filteraid made from a special form of carbon is offered.
190B Great Lakes Carbon Co.

Gasket Material.....Booklet describes "Armalon" felts & includes data on characteristics, detailed list of specific applications, & information on sizes & thicknesses.
197 *E. I. Du Pont

High Alloy Castings.....New General Catalog No. G-159 contains tables to help you select the proper alloy for your casting specs & other useful information.
220 *The Duraloy Co.

Insulated Equipment....Booklet "Specify Silicone Insulated Motors and Transformers and Save", gives the full story on the current revolution in electrical equipment.
159 *Dow Corning Corporation

Insulation.....Snap-On is the one piece pipe insulation molded of fine glass fibers. Available plain or with a variety of jackets in sizes from copper tubing to 36".
179 *Gustin-Bacon Mfg. Co.

Insulation.....Foamglas is completely misture-proof to insure constant high insulating value for the life of tanks. A complete line of mastics, tank coatings, etc. Details.
182 *Pittsburgh Corning Corp.

Metals & Stainless Steel Castings..... Five types of stainless steel and twelve metal formulations are available. Technical bulletin on Metals & Stainless Steel Castings.
25 *Waukesha Foundry Co.

* From advertisement, this issue

SCOPE in INDUSTRY
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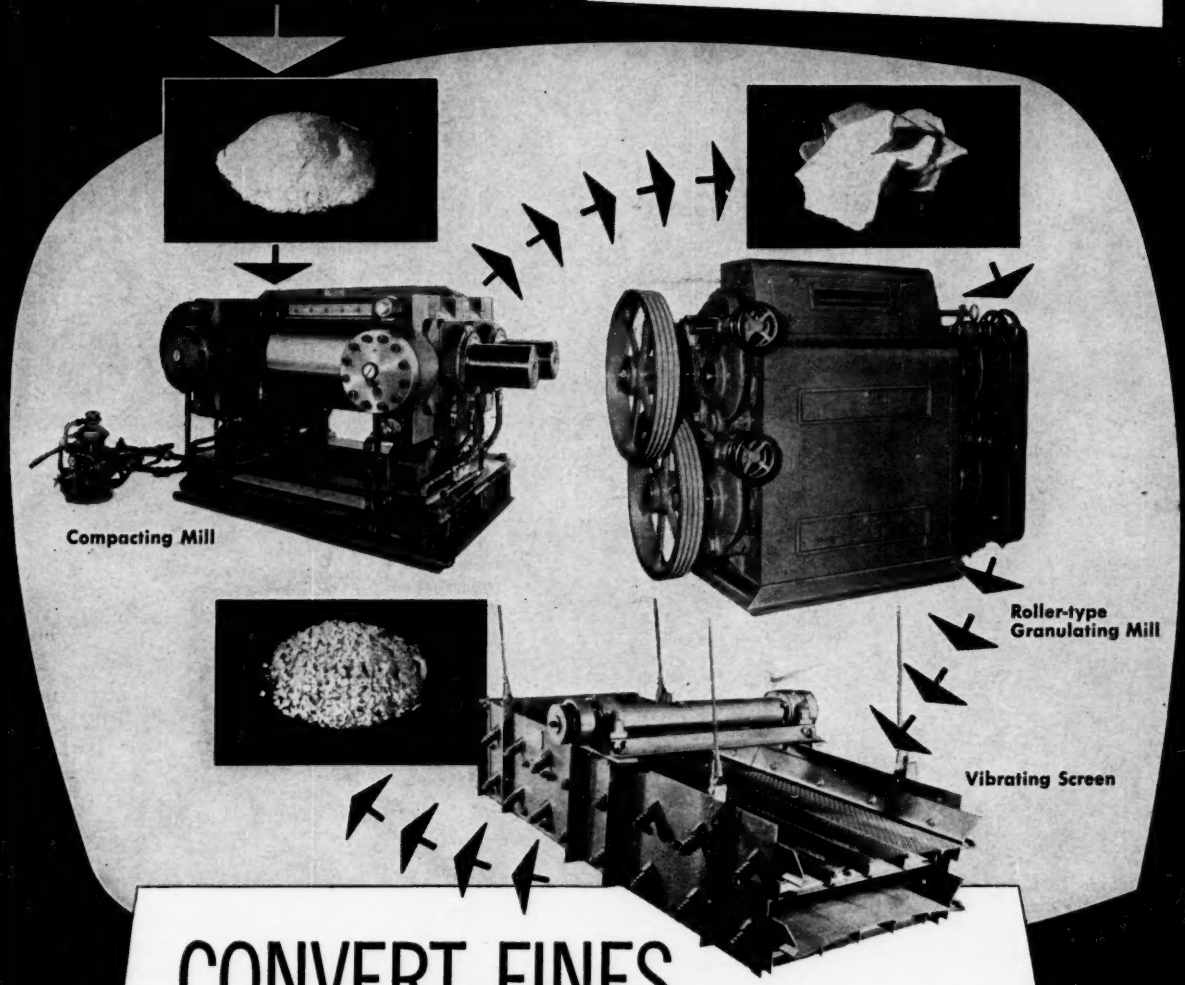

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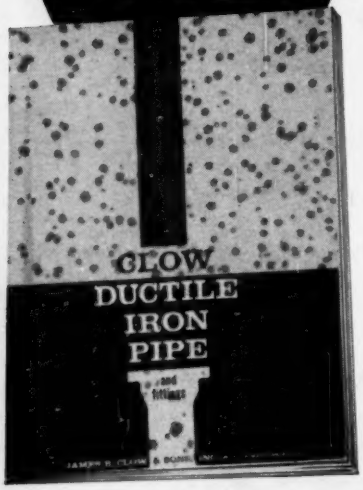

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LITERATURE . . .

Packing.....Compressed Asbestor Sheet #899 will not soften, burn, blow, or ooze out of joint. Can be furnished in a variety of constructions to suit your requirements.
157 *United State Rubber

Packings.....Chempro Style No. 300 "Cup & Con" & Style No. 305 "Wedge" packing ring sets make tight, secure seals under minimum gland pressure. Bulletin CP-552.
186 *Chemical & Power Products, Inc.

Packings.....A complete line of job-specified asbestos packing. For high pressure, semi-high pressure, valve stem packing, gasket tape, etc. Complete information.
54 *Union Asbestors & Rubber Co.

Plastic.....Literature on new Teflon products available to the chemical industry is now available. Includes new expansion joint, thin-wall tubing & larger sheet sizes.
180 *Raybestos-Manhattan, Inc.

Plastics.....New booklet gives product specifications, uses & application techniques for flat & corrugated fiberglas reinforced plastics in plant maintenance & construction.
192A American Polyglas Corp.

Platinum Group Metals.....typical uses include linings for vessels, electrical contacts, rupture discs, electrodes, anodes & laboratory ware. Bul. PLA-1.
4 *Texas Instruments Inc.

Shaft Seals.....Bulletin No. S-233 covers the application & construction of Type 20 Single Face & Type 20 Double Face Shaft Seals for severe corrosion service.
192B Crane Packing Co.

Tantalum Equipment.....For the new processing line . . . a condenser, a bayonet heater, thermowell or any other tantalum acid-proof equipment. Information.
42 *Fansteel Metallurgical Corp.

Wire Cloth.....from any metal or alloy including titanium. In nine basic weaves from finest to coarsest mesh. A 94-page catalog is offered.
46 *The Cambridge Wire Cloth Co.

Worm Gear Drives.....Bulletin 135-S contains dimensions, cutaway views, rating tables, charts and information on cooling tower drive selection.
161 *The Cleveland Worm & Gear Co.

Electrical & Mechanical

Drive.....Poly-V Drive solves difficult drive problems wherever heavy duty power transmission is required. Assure constant speed ratios. Bulletin M141.
28 *Raybestos-Manhattan, Inc.

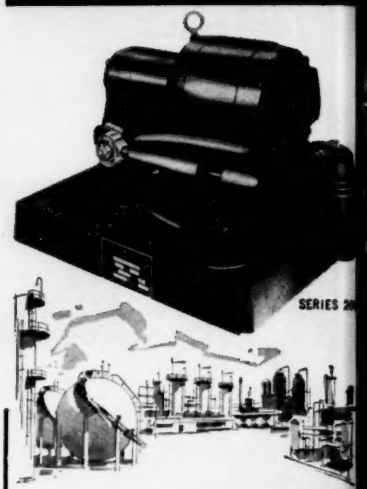
Drive Unit.....Information on new Kinatrol line of eddy-current coupling adjustable-speed drives. Includes data on torque capabilities, regulation and operation of drive.
192C General Electric Co.

Drives, V-Belt.....Bulletin No. 9102 includes drive-selection and horsepower tables, sheave and belt specifications and installation instructions for sheaves.
192D T. B. Wood's Sons Co.

* From advertisement, this issue

ACCURATE CHEMICAL FEEDING

FROM .65 gph TO 1624 gph



AMERICAN PROPORTIONING PUMPS have repetitive metering accuracy of ± 1% when operating between 10% and 100% of capacity. Feed precisely metered fluids or slurries in all ratios, with controlled process variables.

- interchangeable liquid ends
- spherical self-aligning bearings on crank and crosshead
- crossheads of hardened and ground steel ride on cast iron
- nylon dust covers protect bearings
- NEMA frame motors
- heavy duty reducers

Send for free bulletin.

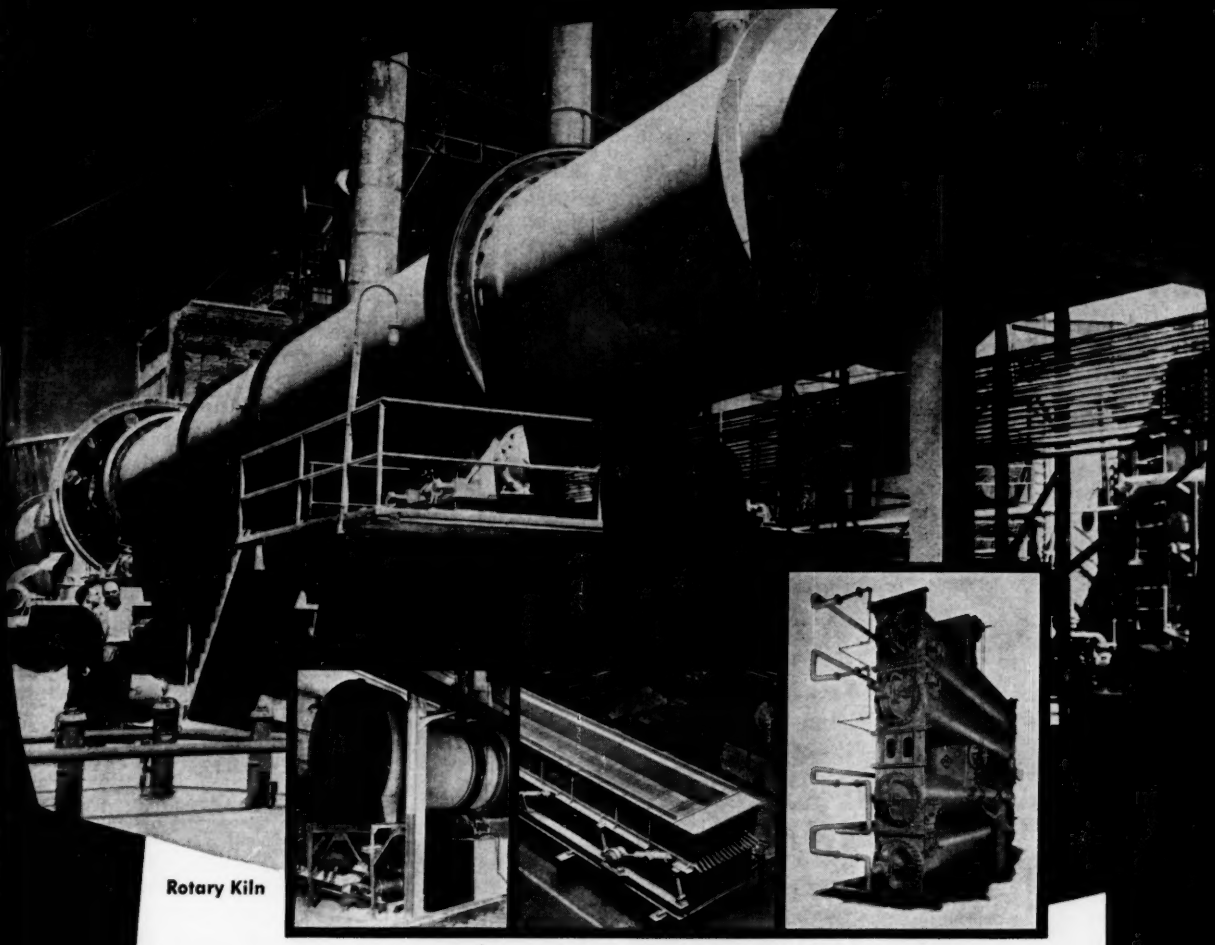
SERIES 100
Simplex models pump up to 13.10 gph at maximum pressure of 1000 psi. Duplex models double that capacity.

SERIES 200
Simplex models pump up to 812 gph at maximum pressure of 1000 psi. Duplex models double that capacity.

AMERICAN METER COMPANY
INCORPORATED ESTABLISHED 1836
pump division
13500 PHILMONT AVE., PHILADELPHIA 16, PENN.

SCOPE in INDUSTRY
SPECIALIZATION from...

ALLIS-CHALMERS



Rotary Kiln

Rotary Dryer

Air-Quenching Cooler

Ribbon-Flight Dryer

Integrated heat-transfer systems from Allis-Chalmers cut costs

At Allis-Chalmers, building a heat-transfer system is not just a matter of picking components and hooking them together.

A-C relates the flow variables of each component to the characteristics needed for the whole process.

Typical of the research and testing facilities which make this thorough analysis possible is the new A-C pilot plant which includes a complete *Grate-Kiln* system. Components, processes and techniques may be studied carefully under actual operating conditions. The results from these tests help A-C bring you the latest scientific advances in pyro-processing in each system you buy.

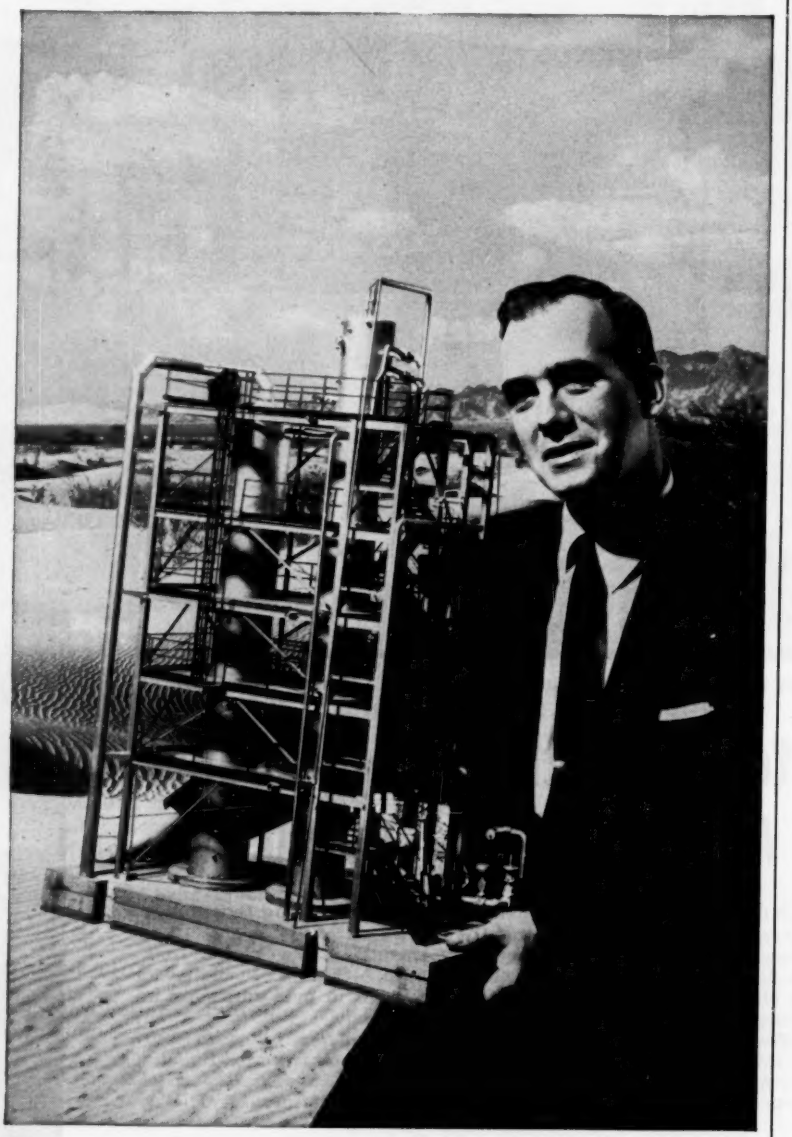
For more information, talk with your A-C representative. Or write for Bulletin 25C6177, to Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wis.

A-C ALLIS-CHALMERS

A-1190-C

KEEP YOUR PLANT DESERT-DRY WITH LECTRODRYERS—It's like taking your plant to the desert if you eliminate unwanted moisture with Lectrodryers. Controls work smoothly and dependably when instruments are fed dry, clean air. Processes stay on the beam and product quality is consistently high, when the air, gases or organic liquids involved are dry. Desert dryness in warehouses safeguards products stored there.

Lectrodryers dry to dewpoints below -110°F.—in volumes of a few cubic feet or thousands per hour. Operation can be fully automatic or manually controlled. Quite likely, there are standard units to suit your needs, or we can recommend special equipment. For this help, write Pittsburgh Lectrodryer Division, McGraw-Edison Company, 303 32nd St., Pittsburgh 30, Pa.



Lectrodryer® McGRAW EDISON

LITERATURE . . .

Gaskets, Spiral-Wound.....Flexi Finish provides for ease of identification and a clean, long-live installation. Samples available on request.
225 *Flexitallic Gasket Co.

Motor control Lines.....Complete information & helpful application data on Safair and Safuse Magnetic Control are available. Publication 242A & 249.
18-19 *E-M Elec. Mach Mfg. Co.

Motor Control.....Illustrated construction details, typical layouts and methods of figuring combinations are given in Bulletin SPM-1-1159, describing three systems.
194A Automatic Control Co.

Motors.....Bulletin No. 196 describes dripproof motor which manufacturer claims can be used in many places previously regarded as too severe for dripproof motors.
194B Sterling Electric Motors

Pressure Blowers.....High capacity Pressure Blowers feature airfoil blading, inlet capacity control, and Westinghouse designed blower and motor combination. Details.
39 *Westinghouse Electric Corp.

Synchronous Motors.....Bulletin 05B-9522 shows construction features of motors that help maintain efficiency at fractional or full loads, correct power factor.
194C Allis-Chalmers Mfg. Co.

Rectifiers.....Semi-conductor rectifiers such as germanium, silicon & selenium, as well as mercury arc rectifier units of the pumped or sealed type. Complete information.
195 *Allis-Chalmers

Thermocouples.....Ceramo thermocouples for problems of high temperature, moisture, abrasion, corrosion or difficult installation. Details in EDS-45-4.
101 *Thermo Electric Co., Inc.

Turbines, Solid-Wheel.....are available in vertical designs depending on frame size. Capacities from 5 to 2,000 HP. Described in Bulletin S-116.
48 *The Terry Steam Turbine Co.

Handling & Packaging

Air Hoists.....A complete line for loads to 4000 lbs. Bul. 87-1 describes air hoist that lifts & lowers . . . "Hoistractor" that moves hoist & load along the beam.
94 *Gardner-Denver Co.

Automatic Bag Closer.....Model BA-6 sews at rate of 30 feet per minute. Details & Complete catalog-file of bag closing equipment are available on request.
B204 *Dave Fischbein Co.

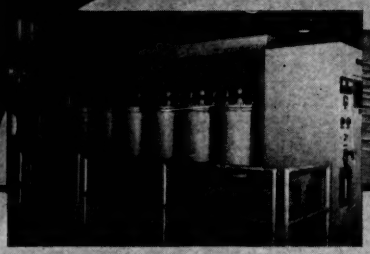
Bucket Elevators.....Complete line includes 14 types in 4 basic designs . . . centrifugal, positive, continuous and internal discharge. Complete details.
21 *Link-Belt Co.

Conveyors.....Natural-Frequency conveyors are easily cleaned and feature dynamic balancing. Widths to 10', lengths to 500'. Further information on request.
162 *Carrier Conveyor Corp.

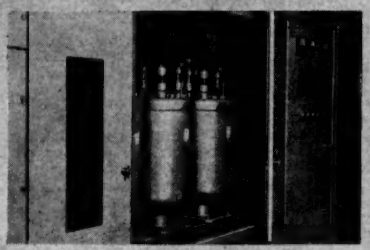
* From advertisement, this issue

SCOPE in INDUSTRY
SPECIALIZATION from...

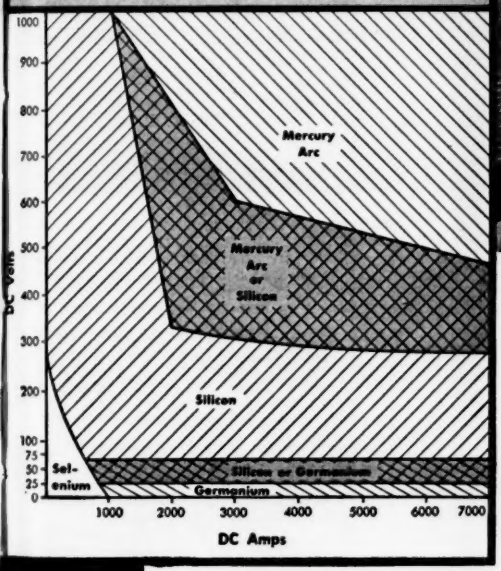
ALLIS-CHALMERS

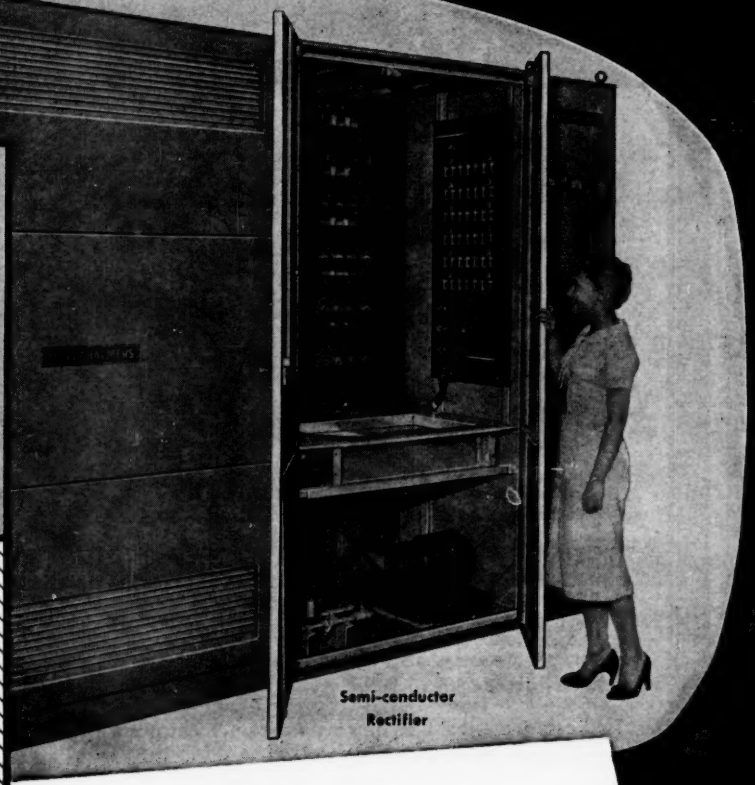


Open pumped tube Mercury Arc Rectifier



Enclosed sealed tube Mercury Arc Rectifier





Allis-Chalmers takes the confusion out of power conversion

Right-for-the-job rectifier

Available to Electrochemical Industries

There's only *one* type rectifier that's *right* for your electrochemical application. Use the above chart as a guide. It shows the approximate direct current and voltage ratings that best fit the various types of rectifiers. After checking the chart, check with Allis-Chalmers. Thirty years' experience in developing, building and applying rectifiers equips A-C to analyze your needs and make a pinpoint recommendation.

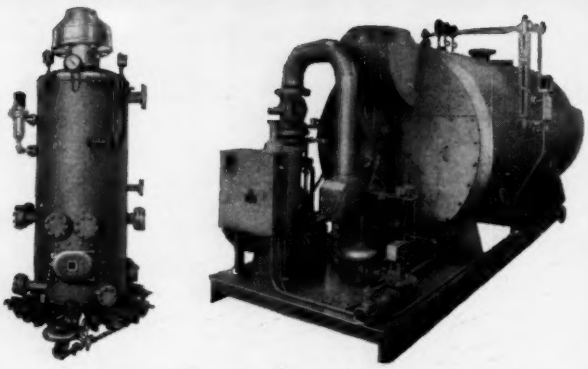
Allis-Chalmers makes all static types

Allis-Chalmers builds semi-conductor rectifiers such as germanium, silicon, and selenium, as well as mercury arc rectifier units of the pumped or sealed type in open or enclosed construction. Because Allis-Chalmers can supply this wide variety of power rectifiers, our recommendation is always completely unbiased — never influenced by commercial expediency. For complete information, call your A-C man or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin. In Canada, write Allis-Chalmers Ltd., Box 37, Montreal, Quebec.

A-C ALLIS-CHALMERS

A-5955 C

Lower Processing Costs with Eclipse Vaporizers and Liquid Phase Heaters for Dowtherm*



Vertical units rated to 2 million Btu, and horizontal to 6 million Btu.
Vaporizers shown are typical of complete Eclipse line.

Eclipse fire-tube vaporizers and liquid phase heaters provide lower processing costs on high-temperature applications because of these factors:

1. Low operating pressures reduce equipment costs — for example, 95 psig for 700° F.
2. Up to 1/3 lower insurance rates.
3. Elimination of fire hazards involved in direct-fired process heating.
4. Precise temperature control eliminates overheating or underheating in critical processes.
5. Compact installation requires minimum floor space.
6. Directed flow, natural circulation that scrubs heating surfaces vigorously for faster heat transfer, no violent boiling of liquid, and no build-up of scale on heat exchange surfaces.

For more data on Eclipse Vaporizers and liquid phase heaters, write for Bulletin A-100 describing the complete line available and showing typical installations.

* Write for information on equipment for use with other heat transfer media.

Eclipse

ECLIPSE FUEL ENGINEERING CO.
1121 Buchanan Street, Rockford, Illinois
Export: Ad. Auriema, Inc., 85 Broad St., New York 4, N. Y.

LITERATURE . . .

Conveyors.....Air-Float conveyors provide trouble-free air-gravity conveying of dry materials. No moving parts, nothing to wear, nothing to maintain. Details.
81b *Kennedy Van Saun

Fork Trucks.....Bulletin SS-2201 describes three low-silhouette, battery-powered trucks. Complete specifications and drawings. Charts illustrate lift heights and speeds.
196A Clark Equipment Co.

Materials Handling Equipment..... Illustrated brochure covers every feature of the FT Series Lift Truck. Includes engine specifications, accessories, attachments, etc.
196B Allis-Chalmers

Payloader.....Model H-25 offers combination of 2,500 lb. carry capacity, only 6 ft. turning radius, power-shift transmission, power-steering, etc. Data.
90 *The Frank G. Hough Co.

Screeners.....32-page brochure contains information on construction, screening action, installation and maintenance with comparative table for silk, nylon & wire cloth.
196C Orville Simpson Co.

Vibrating Conveyors.....features an exclusive dual-shaft vibrating mechanism with splash oil lubricating system. Complete information in illustrated bulletin No. 5602.
181 *Lecco Machinery & Engr. Co.

Weighing System.....Literature is graphic, descriptive and easy to use in figuring a system for your installation. Available now on request.
187 *The A. H. Emery Co.

Heating & Cooling

Boilers.....Package water tube boilers are available in oil and/or gas fired types in standard pressures of 175,250 and 375 pounds per square inch gage. Literature.
137 *Henry Vogt Machine Co.

Condensers & Heat Exchanger Tube .....Complete information contained in Condenser & Heat Exchanger Tube Handbook which is now available on request.
166 *Bridgeport Brass Co.

Cooling Towers.....with high thermal performance, & built in permanence. Brochure shows why Fluor Towers mean more efficient operation. Available on request.
87 *Fluor Products Co.

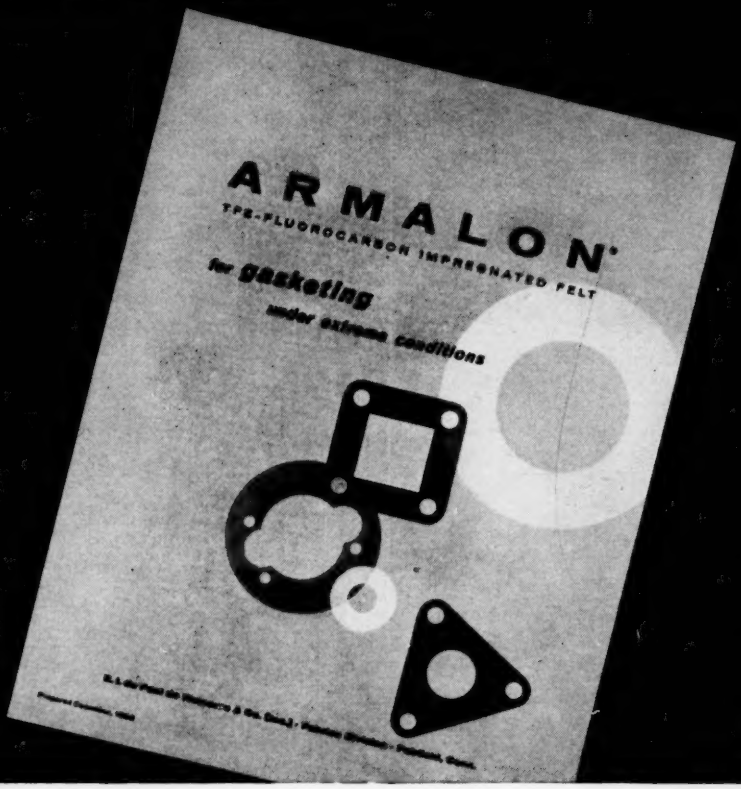
Cryogenic Vessels.....A full line of vessels includes a design to meet most requirements for low temperature storage. Further details available on request.
142 *Chicago Bridge & Iron Co.

Dryer.....Molecu-Dryer models provide optimum adsorption efficiency, and fast desorption & cooling. A comprehensive picture of Molecu-Dryer in Bulletin 5703.
L210 *C. I. Hayes, Inc.

Dryers.....The Oriad Desiccant Dryer offers complete reactivation, full automatic operation, and accurate temperature control. No moving parts. Bul. D-103.
77 *The C. M. Kemp Mfg. Co.

* From advertisement, this issue

FROM DU PONT...



CONTENTS

Fully describes "Armalon" felts—a new class of gasket materials developed by Du Pont for severe service. Includes:

- Complete data on characteristics—physical properties tabulated for ready reference
- Detailed list of specific applications—indicates how and where "Armalon" performs to best advantage
- 7 case histories describing the service performance of "Armalon" gaskets
- Information on sizes and thicknesses available . . . where to buy "Armalon"

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165 Third Ave. at E. 26th Street
Paterson, New Jersey

R. Hurwich Company
2546 10th Street
Berkeley, California

Aero Gasket Company
763 Hanover Road
Meriden, Connecticut

Cinn. Gasket, Packing & Mfg. Co.
1507 Elm Street
Cincinnati 10, Ohio

Southwestern Rubber & Packing Co.
P. O. Box 5173
Houston, Texas

Gasket Manufacturing Co., Inc.
319 West 17th Street
Los Angeles, California

Russell Gasket Company, Inc.
7424 Bessemer Avenue
Cleveland 27, Ohio

Free booklet tells how you can reduce gasketing costs

If you're troubled with constant gasket failure, you'll want a copy of *"Armalon"—for gasketing under extreme conditions.* "Armalon"** TFE-fluorocarbon impregnated felts withstand temperatures from -100°F. to 400°F., resist strong acids and bases—including red fuming HNO_3. "Armalon" gaskets seal securely and last months, even years, longer than other materials. For examples of how these amazing materials are being used to lower operation costs throughout industry, and complete technical data on Du Pont "Armalon"*. . . send for the booklet illustrated. Clip the coupon now. Mail to E. I. du Pont de Nemours & Co. (Inc.), Fabrics Div., Dept. CE-911, Wilmington 98, Delaware.

**"Armalon" is Du Pont's registered trademark for its TFE-fluorocarbon resin impregnated felts.*

***"Armalon" TFE-fluorocarbon impregnated felt is covered by U. S. Patent 2,764,506.*

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Please send me a copy of *"Armalon"—for gasketing under extreme conditions.*

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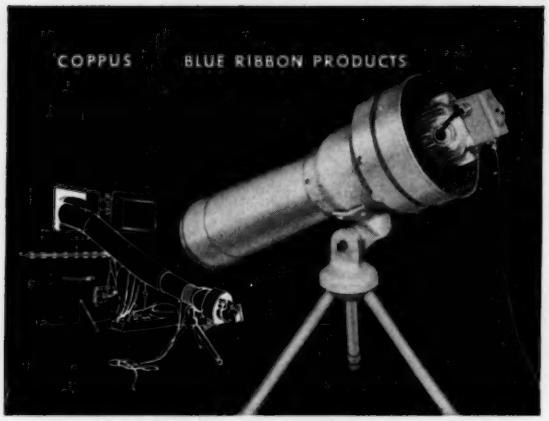

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- ☐ in tanks, tank cars
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A UNIQUE CHECK VALVE THAT'S UNSURPASSED IN WATER, AIR, OIL OR GAS SERVICE

SILENT • SEATLESS • LOW PRESSURE DROP

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OUTPERFORMS • OUTWEARS OTHER VALVES • COSTS LESS TO MAINTAIN

In field service in a wide range of water, gas, air and oil applications, Technocheck's performance and reliability are unsurpassed. Its exclusive design eliminates valve seats. Tight sealing, low pressure drop and long life with low upkeep are some of its important characteristics.

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Cast Iron, Flanged	125	4", 6", 8"
Steel, Male Threaded Ends	150	1½", 2", 2½", 3"
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PVC, Male Threaded Ends	125	1½", 2", 3"
PVC, Flanged	125	2", 3"
PVC, Flanged	50	4", 6", 8"

We invite inquiries on other sizes and in special materials.

Techno Corporation Dept. CE
16 West 5th Street, Erie, Pa.

LITERATURE . . .

Dryers.....Lectrodryers dry to dew-points below 110 F., in volumes of a few cubic feet or thousands per hour. Operation can be fully automatic or manually controlled.
194 *Pittsburgh Lectrodryer Div.

Generator.....All Model AA Generators are designed to operate at top efficiency over a modulation range of 20% to 100% of rating. Details on new model AA Package Boiler.
45 *Ames Iron Works, Inc.

Heat Exchanger Equipment.....with working pressures as high as 10,000 psi. Bulletin 827 outlines the industrial heat exchangers that are available.
164 *The Vilter Mfg. Co.

Heat Exchangers.....Complete data on copper base alloy, steel and stainless steel fixed-tube-bundle heat exchangers. Includes instructions on selection of exchangers.
198A Young Radiator Co.

Heat Transfer.....The new Multi-Zone Platecoil introduces a new principle of coil design. Solves tough tank & process heating problems. Data in Bul. P61.
95 *Tranter Mfg. Co.

Heat Transfer.....A complete treatment of the subject of Cost Engineering in heat transfer is now available in pamphlet form, upon request.
103 *Western Supply Co.

Heating System.....Controlled hot-water system is described in a brochure illustrating construction and application, including temperature ranges and heating capacities.
198B Robertshaw-Fulton Controls

Heating Tapes.....are extremely flexible. Available in ½" & 1" widths, in standard lengths from 4 to 40 ft. with plug & cord, or in any special length. Bul. 4-B-1.
30 *Glas-Col Apparatus Co.

Kilns.....Bulletin No. 1115 contains complete information on Kilns, Coolers and Slakers. Kilns feature operating economy, advance design and rugged dependability.
26 *Traylor Engr. & Mfg. Div.

Kilns, Dryers, Coolers.....for heat-transfer efficiency. Flow design prerecommendation research and testing, & installation are all included. Bulletin 25C6177.
193 *Allis-Chalmers

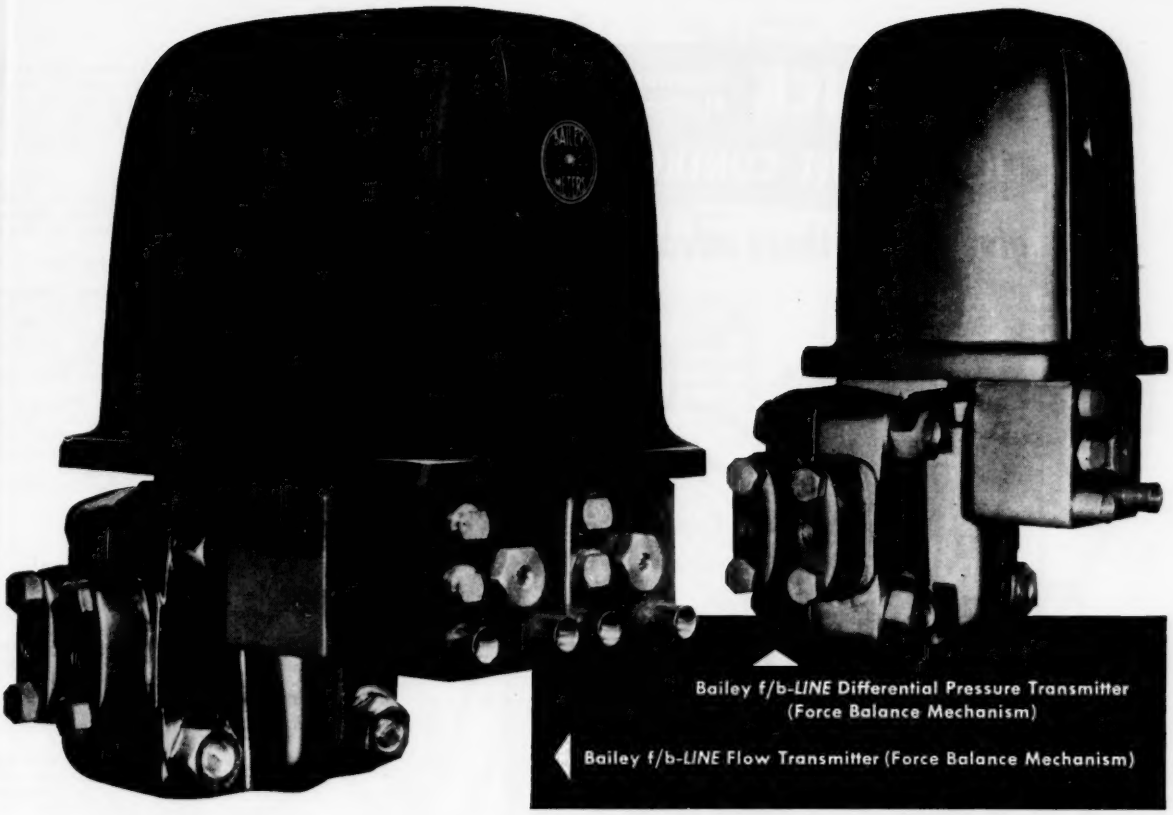
Panelcoil.....now available in 26" and 29" width in all standard lengths up to 143". Dean Data Sheet 15-60 series and Price Bulletin 259 are offered.
R189 *Dean Products, Inc.

Steam Trap Sizer.....Chart shows proper trap number, orifice size, and piping connection description. Covers high-pressure cast iron, steel and brass steam traps.
198C The Clark Mfg. Co.

Steam Trap combined with fine screen strainer for all types of steam equipment. All the details are contained in the Steam Trap Book.
L175 *Yarnall-Waring Co.

Steam Traps.....Information on trap capacity ratings, plus data on how to correctly size, install & maintain for any pressure, temp., or load. A 48-page Book.
165 *Armstrong Machine Works

* From advertisement, this issue



Bailey f/b-*LINE* Differential Pressure Transmitter (Force Balance Mechanism)

Bailey f/b-*LINE* Flow Transmitter (Force Balance Mechanism)

Two new Bailey *f/b-LINE* Transmitters

permit new accuracy in measuring flow and differential pressure

Pneumatically transmits rate of flow—or differential pressure—measurements to indicating, recording, and/or controlling equipment at remote stations. Transmitters consist of a diaphragm measuring mechanism and a force balance pneumatic transmitting unit.

APPLICATION

For steam, water, air, gases and other fluids producing differentials across primary elements from 0-2 in. H_2O to 0-2000 in. H_2O at maximum service pressure of 50, 1500, and 5000 psig.

FEATURES

Transmits a Signal Directly Proportional to Rate of Flow. Uses receiver with uniformly-graduated chart or scale. Eliminates need for external square-root extractors or characterizers.

10 to 1 Turndown. Differential range of each diaphragm measuring element may be changed by factor of 10 to 1; e.g., 0-20 in. H_2O diaphragm may also measure 0-2 in. H_2O.

Screwdriver Adjustments. Range and zero adjustments readily accessible. Range may be changed with screwdriver adjustment.

Overpressure Protection. Protects against full service pressure applied to either side of diaphragm.

Fast Response. No viscous dampers needed, so speed of response is very fast.

Corrosion Resistant. For maximum differentials between 20 and 2000″ H_2O, all parts in contact with process fluid may be stainless steel. No sealing fluids or sealing diaphragm required.

Good Stability. Reset type boosters give good stability with high gain.

Versatile Mounting. May be mounted on process piping, wall, or separate mounting pipe using same bracket.

For additional information, call your local Bailey District Office, or write direct.

CP3-1

Chemical and petroleum division

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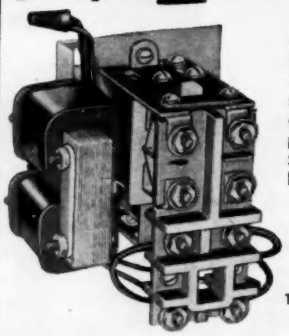
WARRICK Floatless Electrode Type

LIQUID LEVEL CONTROLS . . .

give you all these advantages!



No moving parts in the liquid • Easy to install • No adjustments necessary • Unaffected by acids or caustics • Unaffected by pressure or temperature • Standard 2&3 pole units listed by U/L

Write for 32-page Catalog which gives complete specifications

Two pole control shown at left

YOU CAN USE OUR CONTROLS FOR:

- Single & Multiple pumps
- Motor & solonoid valves
- High & low cutoffs & alarms
- Condensate contamination
- Storage tanks
- Volumetric Metering
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More Capacity

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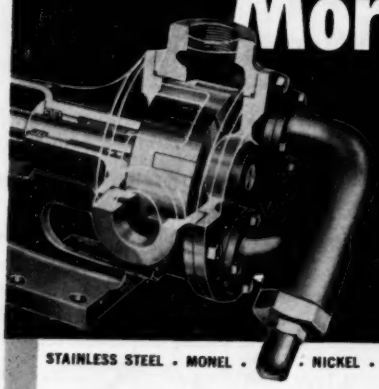
PUMPS



STAINLESS STEEL • MONEL • NICKEL • NI-RESIST • DUCTILE IRON • AND OTHERS

At new rated speeds, capacities are doubled in some cases, with the new line of Viking Heavy-Duty Rotary Pumps. On thin liquids, pumps are operated up to 100% rated speed. Resultant savings amount to as much as several hundred dollars.

These new rated speeds are possible because of our entirely new, modern electric foundry facilities and manufacturing processes. They enable us to meet more exacting requirements than ever before throughout the complete line of Viking alloy pumps.

If your specifications call for stainless steel or other alloy pumps, see how you, too, can save.

Write for Catalog MC

VIKING PUMP COMPANY

Cedar Falls, Iowa, U.S.A. • In Canada, it's "ROTO-KING" Pumps
See Our Unit in Chemical Engineering Catalog

LITERATURE . . .

Steam Traps.....Thermo-Dynam c Steam Trap TD-50 never bloc heat transfer and they remove cor - condensate & air as fast as they collec . Information Tracer Line Trappin . 188 *Sarco Co.

Tube & Shell Exchangers.....Litera - ture is available on Tube & Shel . Cross-Bore, Parallel, Cubic, Modu - lar, Immersion, etc. Also a 32-p . booklet. 31 *Falls Industries, Inc.

Vaporizers & Liquid Phase Heater s .....Bulletin A-100 describing th complete line available and show - ing typical installations is now offered for your information. 196 *Eclipse Fuel Engr. Co.

Ventilating Equipment.....New bulle - tin describes collecting hoods, duct and stacks, elbows and other fit - tings. Includes specifications an chemical . sistance data. 200A Heil Process Equipment

Instruments & Controls

Actuator.....Type 470 delivers same power in either direction at any point of the stroke. Available in six basic sizes & for travel up to 4". Bulletin E-470. 176 *Fisher Governor Co.

Balances.....8 p. folder pictures and describes a line of analytical bal - ances. Chart outlines performance characteristics of the complete line. Send for your copy. 200B Will Corp.

Belt Weigher.....Pneu-Weigh offers extremely high accuracies, wide ranges, capacities in compact, un - complicated unit, Bulletin 36.20-1 for details. 169 *B-I-F Industries, Inc.

Computer System.....The Internal Reflux Computer System can be supplied with either pneumatic or electrical output. Components are all standard proven units. Details. 14-15 *Taylor Instrument Co.

Control Systems.....Information on design, manufacture and applica - tion of Tendamatic Control Systems for all types of compressor installa - tions contained in Form 3276. 22-23 *Ingersol-Rand

Data Processing.....Booklet is avail - able on data collecting system that automatically channels information from work stations to central proc - essing point. 200C Friden, Inc.

Drum Computer.....Catalog describes RPC-4000 electronic computer for data processing. System contains computer and tape typewrite input - output unit. 200D Royal McBee Corp.

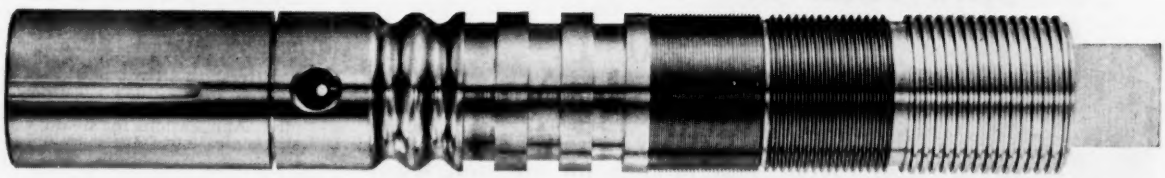
Electronic Gauge.....provides com - plete automation in gauging liquids & solids. Measures alcohol, asphalt, flour, wood pulp, etc. Details on request. 27 *Gilbert & Barker Mfg. Co.

Gauge.....Liquidometer gauges indi - cate exact level at all times. The gauge operation is completely auto - matic. Tank Gauge measures virtually any liquid. Details. 172 *The Liquidometer Corp.

* From advertisement this issue

THEY LAUGHED WHEN WE SAT DOWN TO PLATE...

they didn't know about **KANIGEN®**



This shaft was turned. It was key-slotted, drilled, tapped and shouldered. It was threaded, milled, grooved and chamfered. It was step-bored, with three inside diameters. Who could plate a piece like this all over—inside and out—and expect a uniform coating?

Well, anyone who used KANIGEN® could expect it—and get it. In fact, we made this piece especially to prove it.

The KANIGEN® process for chemical nickel alloy plating produces a uniform thickness of coating, regardless of the contours of a part. This uniformity permits full machining operations prior to coating, with no subsequent cleanup.

KANIGEN® offers corrosion resistance equal or superior to that provided by wrought or electrolytic nickel.

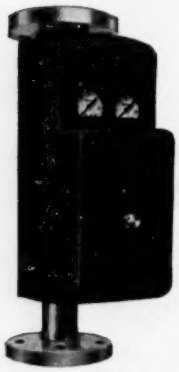
For complete technical details write or call your nearest General American office. Ask for Kanigen Bulletin No. 258. You'll find that with plating as in so many other industrial areas, *it pays to plan with General American.*

Kanigen Division
GENERAL AMERICAN TRANSPORTATION CORPORATION
135 South LaSalle Street • Chicago 3, Illinois
Offices in principal cities

KANIGEN GENERAL AMERICAN TRADE MARK

THE FLOW GOES STRAIGHT-THRU

no pockets, no elbows to gum up the works!



This is the rotameter-transmitter for your toughest flow-metering jobs. Brooks' new Model 3611-MPTX.

You can use it for slurries, still bottoms, Bunker oils, pthalic anhydrides, tall-oil compounds—virtually any 'problem' fluid.

You can use it for electric transmission, pneumatic transmission, or flow integration — or transmission *and* integration.

Above all, you can use it with absolute confidence.

Have a look at the transmitter's unique magnetic float-position converter, and you'll see why.

Design Specification Sheet DS-361 gives details. Write for a copy.

THIS ALL-NEW BROOKS ROTAMETER-TRANSMITTER

BROOKS ROTAMETER COMPANY
260 D STREET • LANSDALE • PENNSYLVANIA

Protects Metals Against Hot Acids, Acid and Sulfurous Fumes, Salt Spray, Steam, Mild Alkalies, Up to 600° F.

Markal "D-A" Coatings will protect metal against any corrosive action. It is an ideal product for ore sintering plants, plating plants, food plants, lumber kilns, foundries, chemical plants, sewage disposal plants, laundries, heat exchangers . . . many others.

Markal "D-A" Coatings are applied by brush or spray and can be air dried or baked. The Coatings will withstand temperatures up to 600°F.

For free sample write on company letterhead, stating temperature extremes, surface temperature at time of application, and corrosive condition.

Other Markal Coatings are available in a complete range of types for any condition and temperatures up to 2200°F. Send for catalog No. MPC.

The Markal Company, 3106 West Carroll Avenue, Chicago 12, Ill.
Telephone SAcramento 2-6085

LITERATURE . . .

Instrumentation.....A complete line of instruments; full-size, miniature, electronic and pneumatic types for measurement, recording, automatic control and telemetering.
40 *The Bristol Company

Instruments.....Bulletin 91-119 is a handy guide to methods available for measuring flow. Practical map to flowmetering. Available now on request.
202A Fischer & Porter Co.

Liquid Level Controls.....Floatless Electrod type are unaffected by acids or caustics. Unaffected by pressure or temperature. A 32-pg. catalog gives specifications.
T200 *Charles F. Warrick Co.

Magnetic Flow Meter.....are lined with corrosion-proof Kel-F and have no flow restrictions of any type. Information on how it can help your process and Bul. 20-14.
31 *The Foxboro Company

Potentiometers.....Electronik potentiometers feature servo Motor, Constant Voltage Module, Measuring Circuit Module and Amplifier Module. Full details on request.
10-11 *Minneapolis-Honeywell

Recorders, Multirange.....Bulletin discusses application, features, principles of operation, with a schematic of recorder and description of accessories.
202B General Electric Co.

Servocontrol Mechanisms.....Bulletin 110 gives a summary of the basic principles and potental applications of electrohydraulic servocontrol mechanisms.
202C NOOG Servocontrols, Inc.

Temperature Regulators.....A variety of temperature regulators designed for your specific needs. Full specifications contained in Catalog D-CC.
171 *Robertshaw-Fulton Controls

Transmitter.....Rotameter-transmitter model 3611-MPTX features unique magnetic float-position converter. Design Specification Sheet DS-361 gives details.
T202 *Brooks Rotameter Co.

Transmitters.....Two new f/b line models permit new accuracy in measuring flow & differential pressure. Applications for steam, water, air, gasses, etc. Information.
199 *Bailey Meter Co.

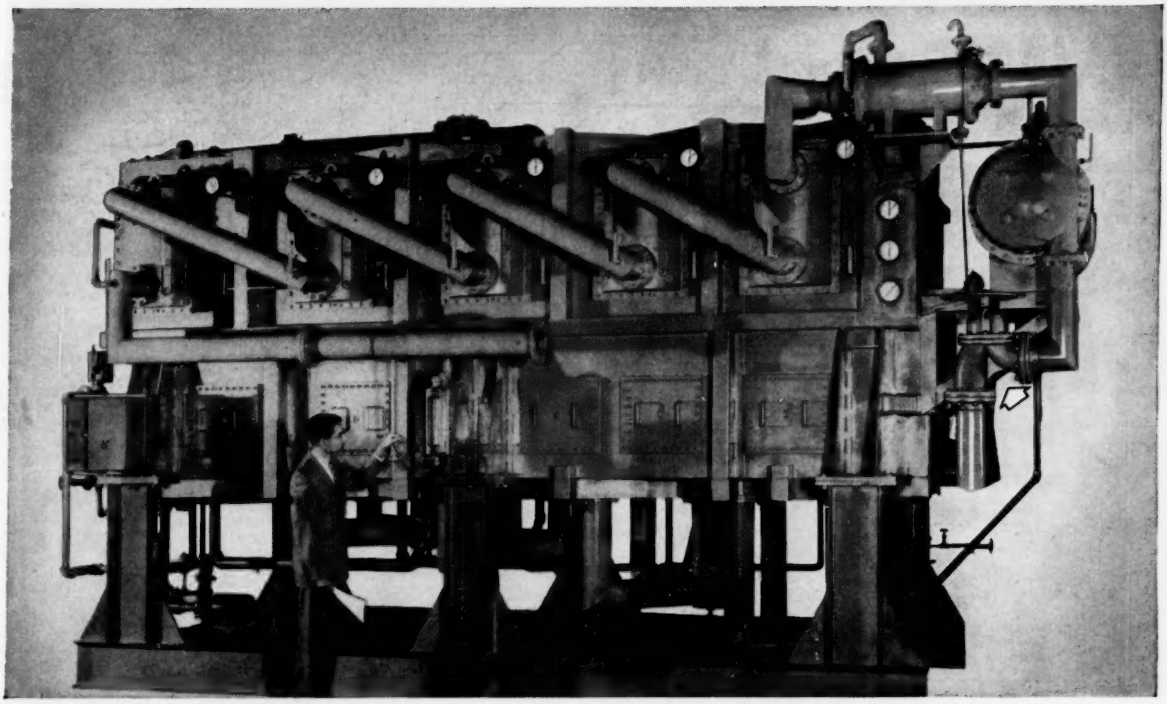
Pipe, Fittings, Valves

Entrainment Separators.....“Karbate” impervious graphite type MV offer complete corrosion resistance . . . low pressure drop, etc. Details in Catalog Section S-6900.
73 *Nat'l. Carbon Co.

Expansion Joints.....Fluoroflex-T expansion joints molded from Teflon offer long trouble-free life & excellent working pressure ratings. Facts in Bul. B-1A.
65 *Resistoflex Corp.

Fittings.....A complete line of stainless fittings in all pressure ratings for 150# thru 6000#. New catalog covering the complete line is now available.
221 *Camco Fittings, Inc.

* From advertisement, this issue



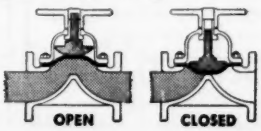
ON LAND At Salinas, a tourist center in Ecuador, this Cleaver-Brooks Flash Evaporator delivers 50,000 gallons of pure, distilled water every 24 hours. It is equipped with two 6", rubber lined, weir-type Grinnell-Saunders Diaphragm Valves — only one of which can be seen from this view.

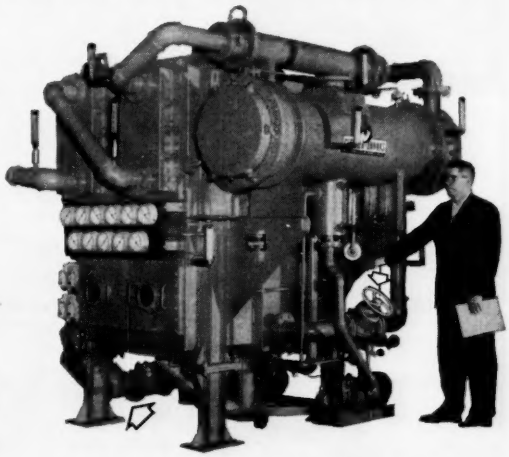
Grinnell-Saunders Diaphragm Valves help convert salt water to fresh water

You can convert sea water to fresh water, in abundant supply, on land . . . or on shipboard, with flash evaporators made by Cleaver-Brooks Special Products, Inc., Waukesha, Wisconsin. Grinnell-Saunders Diaphragm Valves are used as original equipment on these distillation units because they offer positive, leak-tight closure; flow control in throttling position; corrosion-resistance.

You'll find Grinnell-Saunders valves widely used in other fields, too . . . petroleum, papermaking, chemical, food, compressed air . . . to mention a few.

The operating principle of the Grinnell valve is the feature which makes it so adaptable. The diaphragm lifts high for streamline flow in either direction; seals tight for positive closure against grit, scale, solid matter, pressure or vacuum. Bonnet mechanism is completely isolated at all times from the fluid in the line by the diaphragm, preventing corrosion and contamination. Smooth passage, without pockets, eliminates trapping of solids and reduces frictional resistance. And you can get body, lining and diaphragm materials to meet your particular service conditions. Get *all* the facts. Write Grinnell Company, Providence 1, R. I.





AT SEA The nuclear powered NS Savannah has two 16,000 gallons-per-day Cleaver-Brooks distillation units to supply the entire water requirements of crew and machinery. Each unit has two 4" Grinnell-Saunders Straightway Valves of ductile iron.

GRINNELL

Pipe, Fittings, Valves, Hangers, Heating and Piping Supplies
Branch Warehouses and Distributors From Coast To Coast

New...from MARSH!

Conduit-type Master-mite. Grommet-type also available.

Small Solenoid Valves that fill a BIG Order

Designed to meet the need for positive-acting tight-seating valves for use on wide variety of media, including oxygen, hydrogen, acetylene, etc.

Two Types:
Conduit type and grommet type. Port sizes 1/8" and 1/4" NPT.

Ten orifice sizes: 3/64" through 1/4".

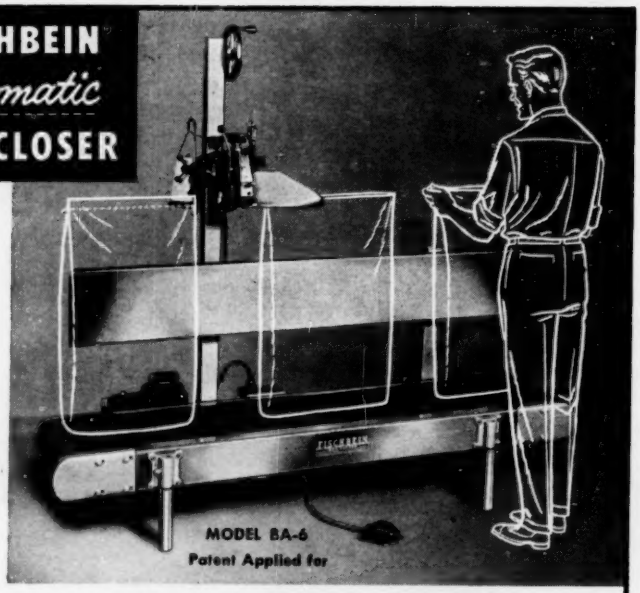
Wide range of voltages:
Standard with 115 V. A. C. but also available in 12, 24, 208, 230, 460 V. A. C.

Pressure to 540 psi.
Small, but with more strength in the Marsh manner. Coils never overheat. Entire assembly leak tight. Remarkably quiet operation. Cleanable without breaking connections. Used in any position. Bodies either brass bar stock or 18-8 stainless steel. All moving parts stainless. Underwriters' approved for use on oxygen and hydrogen and as safety valves.

Write for new bulletin

MARSH INSTRUMENT COMPANY
Dept. 24, Skokie, Illinois
Division of Colorado Oil and Gas Corporation
Marsh Instrument & Valve Co., (Canada) Ltd., 8407 103rd St., Edmonton, Alberta, Canada, Houston Branch Plant, 1121 Rothwell St., Sect. 15, Houston, Texas.

FISCHBEIN Automatic BAG CLOSER



Large Plant Production! Small Plant Price!

- Bag activates and completes sewing operation automatically!
- Simple mechanical operation . . . Simple installation.
- Sews at rate of 30 feet per minute!

An automatic closing unit. The bags themselves start the sewing operation when they reach the sewing head. After sewing is completed, thread is cut automatically and sewing action stops as conveyor belt continues to move bag.

Write for details and complete catalog-file of Fischbein Bag Closing Equipment.

DAVE FISCHBEIN CO. DEPT. 3C
2720 30th Ave. South, Minneapolis 6, Minn.

LITERATURE . . .

Fittings.....Every fitting marked with size, analysis, schedule & production code. Line includes eccentric reducers, crosses, reducing tees, etc. Catalog data available.
85 *Horace T. Potts Co.

Flexible Couplings.....Photographs, diagrams, and tables given for each type of coupling in Catalog 60. Includes facts on dynamic balancing, bore and keyway standards.
204A Thomas Flexible Coupling Co.

Hose, Fittings.....Contains descriptive information on hose and fittings, adapters, self-sealing couplings, cap-plugs and sleeves with selector chart included.
204B Aeroquip Corp.

Pipe, Ductile Iron.....New booklet on Ductile Iron Pipe contains new and better solutions to a difficult piping problem. Available on request.
L192 *James B. Clow & Sons, Inc.

Pipe & Fittings, Jacketed.....All standard types of jacketed fittings are made from 1¼" to 8" line sizes. Complete information in Catalog No. 356.
L211 *Parks-Cramer Co.

Tubing.....A 48-pg. manual for data on Contour-Welded tubing in sizes from ⅛" to 40" O.D., in stainless & high alloy steels, titanium, zirconium, zircalloy & Hastelloy.
47 *Trent Tube Co.

Tubing, Stainless.....A wide range of materials & large diameters with walls as thin as .032". A 32-pg. booklet of technical data, grades & suggested applications is offered.
145 *Allegheny Ludlum Steel Corp.

Valve.....New Type G Sleeveline is a non-lubricated plug valve. For sulfuric acid service, caustic service, solvent handling, etc. Bulletin V/12 available on request.
149 *The Duriron Company, Inc.

Valve.....In field service in a wide range of water, gas, air and oil applications. Information on all sizes & special materials of Techno-checks is offered.
B198 *Techno Corp.

Valve Regulating Relief.....For use at initial pressures to 500 psi. and temperatures to 250 F. will relieve at adjustable pressure ranges 20-70, 50-175, 150-250 and 350-500 psi.
204C Atlas Valve Co.

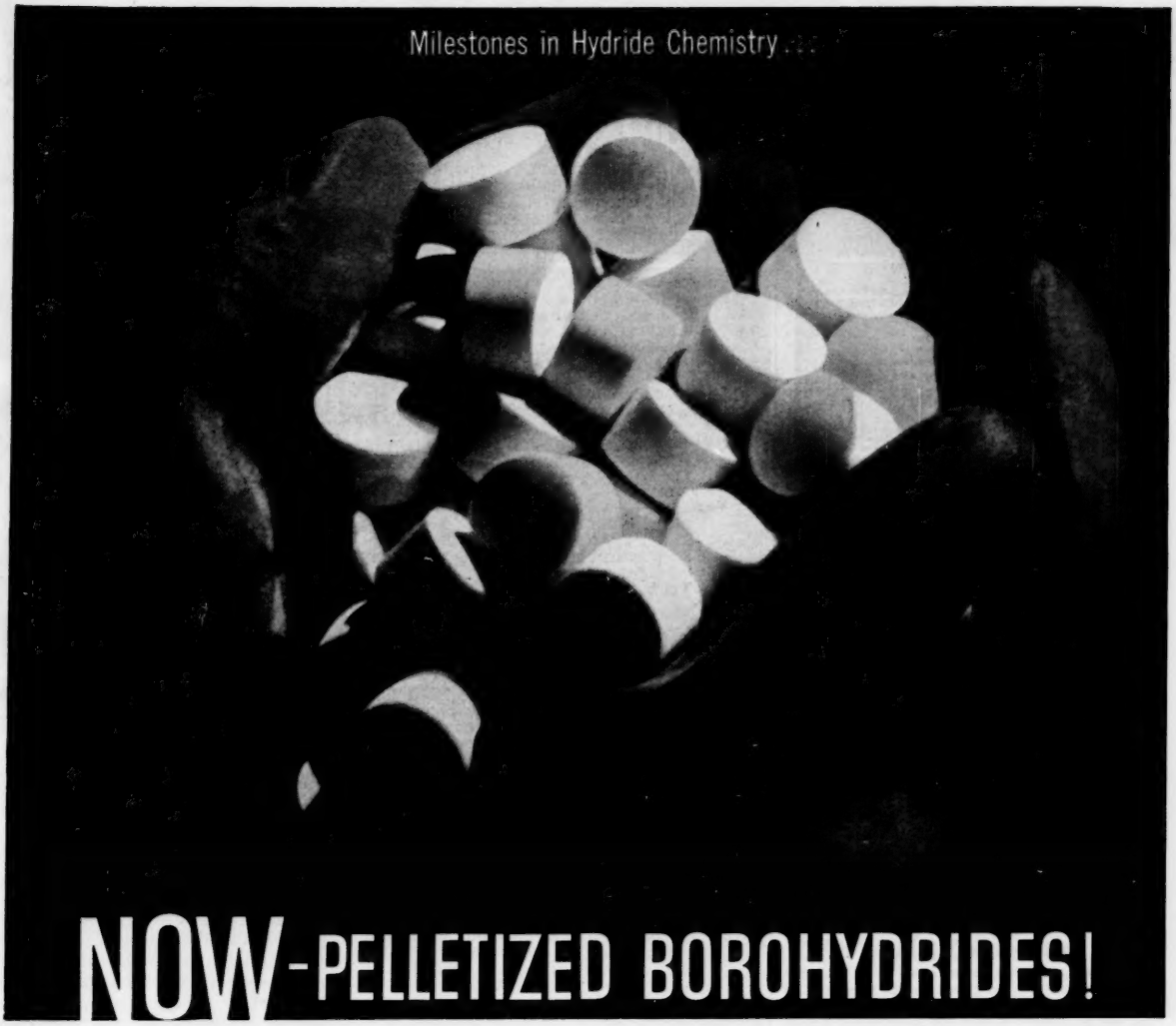
Valve Controls.....The new Limitorque Type P-2 for motorized automatic operation of small globe and gate valves is outlined in special Bul. 21-58.
24 *Philadelphia Gear Corp.

Valves.....Catalog 91022 describes complete line of two-way valves for air, oil, water, gas or chemicals. Includes specifications, outstanding features, and dimensions.
204D Airmatic Valve, Inc.

Valves.....All-Plastic valves stop corrosion and contamination when handling chemicals or critical liquids. Specifications & recommendations in catalog.
R223a *Chemtrol

Valves.....Series 711 Flo Ball valves operate at pressures to 300 psi, temperatures to 400 F. Feature replaceable seats, two-way flow, etc. Technical data on request.
33-36 *Hydromatics, Inc.

* From advertisement, this issue



NOW-PELLETIZED BOROHYDRIDES!

For continuous fixed-bed, in-stream carbonyl group and peroxide reductions

High purity MHI sodium borohydride and MHI potassium borohydride are now available in smooth, cornerless pellets. Simplifying handling and eliminating dust, the new pelleted borohydrides open applications in fixed-bed purification to remove carbonyl or peroxides from gaseous or liquid olefins, diolefins, alcohols and glycols, amines and aminoalcohols, ethers and polyethers, acrylonitrile and chlorinated hydrocarbons.

Sizes of the new pellets are 10/32″ and 24/32″ in diameter. Bulk density averages five pounds to the gallon. The pellets are hard and resist crushing or dusting. Further information and technical service is yours without obligation. Write, wire, or phone today!

New, too! $NaBH_4$-SWS Write for complete details concerning MHI Sodium Borohydride SWS — the new stabilized water solution form that cuts the price of $NaBH_4$ more than in half!

CHEMICAL HYDRIDE DIVISION

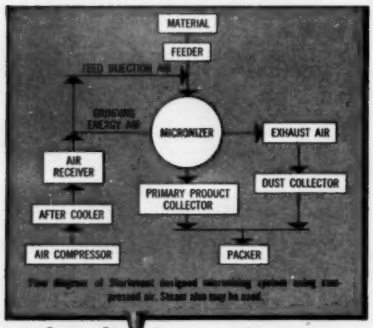
Metal Hydrides Incorporated

PIONEERS IN HYDRIDE CHEMISTRY

28 W. CONGRESS STREET, BEVERLY, MASSACHUSETTS

Need ½ to 44 Microns?

Sturtevant Micronizers* Make 325 Mesh Obsolete



Flow diagram of Sturtevant designed micronizing system using compressed air. Steam also may be used.

One Operation Reduces, Classifies

Sturtevant Micronizers grind and classify in one operation in a single chamber—provide fines in range from ½ to 44 microns to meet today's increased product fineness needs. Can handle heat-sensitive materials.

Production Model (15 in. chamber)

No Attritional Heat

Particles in high speed rotation, propelled by compressed air entering shallow chamber at angles to periphery, grind each other by violent impact. Design gives instant accessibility, easy cleaning. No moving parts.

Classifying Is Simultaneous

Centrifugal force keeps oversize material in grinding zone, cyclone action in central section of chamber classifies and collects fines for bagging. Rate of feed and pressure control particle size.

Eight Models Available

Grinding chambers range from 2 in. diameter laboratory size (½ to 1 lb. per hr. capacity) to large 36 in. diameter production size (500 to 4000 lbs. per hr. capacity). For full description, request Bulletin No. 091.

Engineered for Special Needs

A 30 in. Sturtevant Micronizer is reducing titanium dioxide to under 1 micron at feed rate of 2250 lbs. per hr. For another firm, a 24 in. model grinds 50% DDT to 3.5 average microns at a solid feed rate of 1200-1400 lbs. per hr. A pharmaceutical house uses an 8 in. model to produce procaine-penicillin fines in the 5 to 20 micron range. Iron oxide pigment is being reduced by a 30 in. Micronizer to 2 to 3 average microns.

Sturtevant will help you plan a Fluid-Jet system for your ultra-fine grinding and classifying requirements. Write today.

Can Test or Contract Micronizing Help You?

Test micronizing of your own material, or production micronizing on contract basis, are part of Sturtevant service. See for yourself the improvement ultra-fine grinding can contribute to your product. Write for full details. STURTEVANT MILL CO., 100 Clayton St., Boston, Mass.

*REGISTERED TRADEMARK OF STURTEVANT MILL CO.

LITERATURE . . .

Valves, Butterfly.....may be operated manually or by automatic remote control. Sizes from 2" to 48". Valve is self-cleaning. Bulletin 583 is offered.
178 *W. S. Rockwell Co.

Valves, Diaphragm.....are widely used in many fields. You can get body, lining and diaphragm materials to meet your particular service conditions. Facts.
203 *Grinnell Co.

Valves, Drain.....cannot clog up. Designed so that in the closed position the piston or ram extends up into the tank. In open position, full flow assured. Catalog.
R175 *Strahman Valves, Inc.

Valves, Solenoid.....of forged brass or stainless steel, in ⅛" & ¼" NPT size or JIC tube ends. There's a variety of AC and DC voltages. Bulletin SV-1159.
71a *Hoke, Inc

Valves, Solenoid.....in conduit type and grommet type. Port sizes ⅛" and ¼" NPT. Ten orifice sizes 3/64" through ¼". Wide range of voltages. New bulletin.
T204 *Marsh Instrument Co.

Process Equipment

Aftercoolers & separators.....Bul. 713 covers Air and Gas Aftercoolers & Cyclone Separators. Provide effective low cost moisture removal from compressed air & gasses.
177a *R. P. Adams Co.

Centrifuges.....New 16-page catalog announces 13 improved models. Specifications, photographs, and diagrams are included to show full details.
206A Lourdes Instrument Corp.

Collector.....There's a Mikro-Pulsaire for every collection job, including new modular construction units with capacities to any known requirement. Bul. 52A.
67 *Metals Disintegrating Co.

Compacting System.....is a package of integrated equipment; the new compacting mill, a roller mill & either a gyratory or vibrating screen. Details in Bul. 07B8836.
191 *Allis Chalmers

Crystallization Systems.....The 16-page Engineering bulletin describes the basic details of the crystallization systems & the varied services offered.
83 *Struthers Wells Corp.

Dust Control.....Complete details on Pangborn's engineering knowledge and experience in dust control is now offered to you. Available on request.
167 *Pangborn Corp.

Filter.....The Eimco-Burwell is equipped with an electric timing control circuit & all auxiliaries for automatic operation on a multi-cycle basis. Bul. F-2052.
COVER *The Eimco Corp.

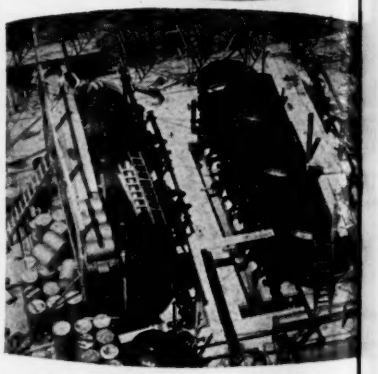
Filter Cloth.....A wide selection of cloths with the right degree of resistance to heat, acids, alkalies, bacterial growth, abrasion, etc. Details on request.
222 *National Filter Media Corp.

* From advertisement, this issue

PATHWAYS OF A PIONEER

ILLCO-WAY DESIGN AND BUILDER

MODERN EQUIPMENT FOR ionXchange



This picture was taken in *1943* of a Continuous *600 gpm* IonXchanger during installation at a midwestern chemical plant. The tanks are shown being loaded with ionXchange resins.

Blazing the Trail fo De-I Developments

When the photograph above was mad IWT already had well over 50 large i dustrial ionXchangers in successful oper tion — yet ion-exchange in those da was still considered a "new and untrie process! Many of these pioneering IW installations are *in use today*, and mo of the early users of IWT ionXchan have *added to* and *modernized* the equipment as new developments becam available.

Even today IWT is still pioneering - adding to its great stock of knowled in this specialized field, designing a building up-to-date ionXchangers of a types and sizes for application to a wi variety of processes as well as all kin of water-treatment, experimenting wi and carefully testing new ionXchan uses, and constantly improving existi designs.

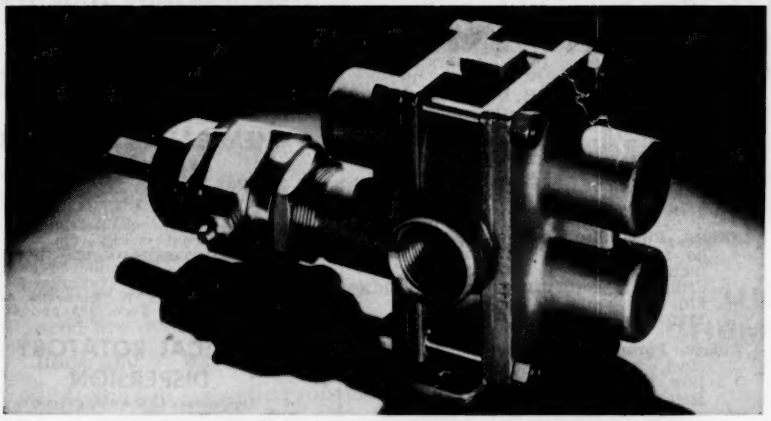
THIS EXPERIENCE CAN MEAN A LOT TO YOU

If you need pure water for high-pressure boiler make-up or process use, or if you are considering the use of ion-exchange for purification or concentration of chemical products, be sure to take advantage of IWT pioneering experience and specialized knowledge. *Call your IWT representative.*

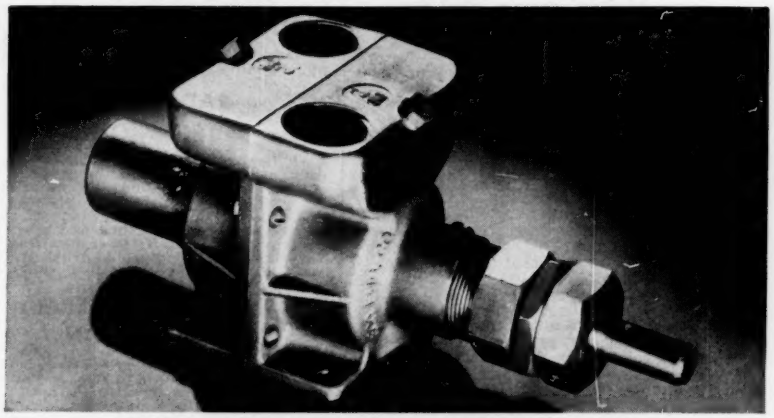
ILLINOIS WATER TREATMENT CO.
840 CEDAR ST., ROCKFORD, ILLINOIS
NEW YORK OFFICE: 141 E. 44th St., New York 17, N.Y.
CANADIAN DIST.: Pumps & Softeners, Ltd., London, Ont.

ECO ENGINEERING NEWS

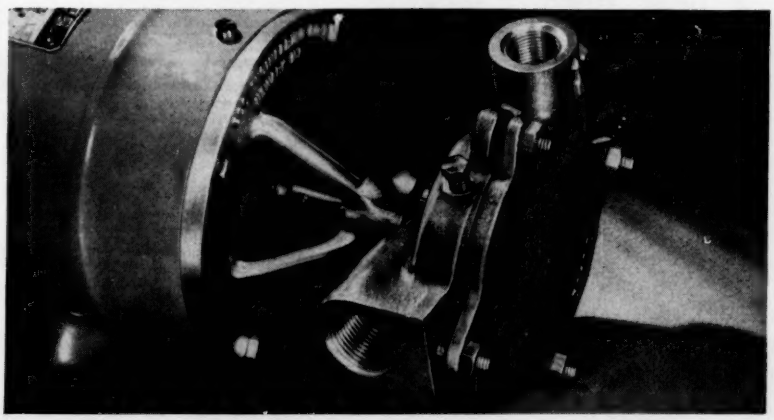
the big name in small pumps for the process industries



ECO GEARCHEM PUMPS



ECO ALL-CHEM PUMPS



ECO CENTRI-CHEM PUMPS

*Union Carbide Trademark. †du Pont Trademark.

THREE BASIC DESIGNS
Serve Most Small Chemical Pump Needs

•

GEAR: If you require self-priming and intermittent or sustained operation with constant flow metering and reproducible accuracy within plus or minus 1 percent, or maintenance of vacuum in the micron range—handling all commercial chemicals, acids, oxidants, alkalies, aromatics, solvents—select the Eco GEARCHEM Pump. For temperatures up to 400° F and viscosities to 10,000 SSU. Capacities to 10 gpm. Pressures to 100 psi.

ROTARY: If you want linear, non-segmented, non-foaming flows, ideal for shear-sensitive emulsions and safe for auto-detonating fluids—select the self-priming Eco ALL-CHEM Rotary displacement pump with twin opposed oscillating impellers. Designed for severe corrosive service. For reduced viscosities and temperatures to 250° F. Capacities to 10 gpm. Pressures to 100 psi. Suitable for metering in conjunction with Rotometers.

CENTRIFUGAL: If you want a widely applicable, corrosive-resistant centrifugal pump handling most chemicals, including slurries with particle size up to 1/16 of an inch, as well as troublesome sticky fluids—select the Eco CENTRI-CHEM Pump. This pump was designed to meet the standardization programs of major, multi-plant chemical companies. Capacities to 40 gpm. Heads to 57 feet.

•

GREAT VERSATILITY

The widest variety of metals and non-metallics for every corrosion and contamination problem are utilized in Eco Pumps. These include the stainless steels, Stellite, Hastelloy* B and C, monel, nickel, zirconium and titanium; Teflon†, phenolic plastics, Hypalon, Nylon, ceramic, carbon, etc.

Mass Produced and Stocked for Immediate Delivery

Eco Pumps are *not* "custom built" with attendant slow delivery and high cost.

They are stock pumps, produced in volume on automatic "program" machine tools where multiple operations are performed to reduce needless labor and handling. This results in lower prices, precision uniformity and complete interchangeability of parts to meet customer requirements and to facilitate field servicing.

Ask for literature on the complete Eco pump line.

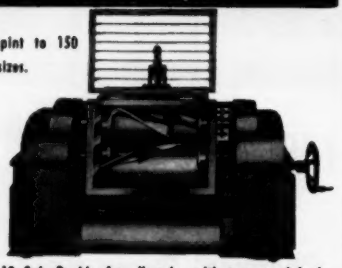
ECO ENGINEERING COMPANY • 12 New York Avenue • NEWARK 1, N.J.

Leading mfrs. of

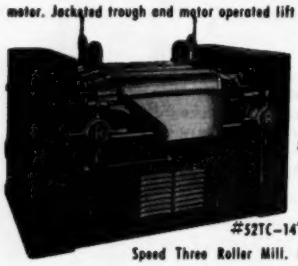
MIXING AND GRINDING EQUIPMENT

for over 90 years

• 1 pint to 150 gal. sizes.



#41L–10 Gal. Double Arm Kneader with two speed brake motor. Jacketed trough and motor operated lift optional.

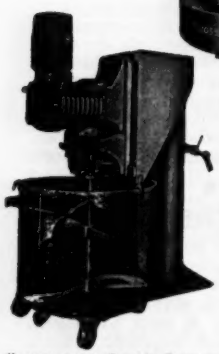


• 4½ x 10, 6 x 14, 9 x 24, 12 x 30, 14 x 32, 16 x 40" sizes

#52TC–14" x 32" High Speed Three Roller Mill. Hydraulic adjustment and pressure recording gauges optional.

#30C–50 Gal. Heavy Duty Change Can Mixer. Adjustable outer scraper, cover with charging port, and gates on cans optional.

• 8, 16, 20, 50 and 60 gal. sizes.



#130H–250 Gal. Change Tank Mixer with hydraulic raising and lowering and variable speed motor. Various type stirrers and high speed impellers optional.

• 80,150 and 250 gal. sizes.

#130EL–1 Gal. Double Planetary type Change Can Mixer with shearing action stirrers, and variable speed reversing type motor. Jacketed cans and portable trucks for cans optional.

• 1, 2, 3, 4, 6, 15, 25, 50, 65, 85, 110 and 150 gal. sizes.

Also Dry Crushing and Pulverizing Mills, Hopper Mills, High Speed Dissolvers or Dispersers, and Mixers of all types for dry, liquid, paste, or heavy paste materials.

Write for complete information!

CHARLES ROSS & SON COMPANY, INC.

150 CLASSON AVENUE BROOKLYN 5, N. Y.

LITERATURE . . .

Filter, Automatic Water.....which is frequently used in recirculation systems where the water is used for less critical applications. Details in Bulletin 909.
177e *R. P. Adams Company, Inc.

Filters, Air.....can eliminate tool malfunction, instrument failure & contaminated products caused by foreign material in compressed air or gasses. Bul. 117.
177b *R. P. Adams Co.

Filters, Chemical.....Completely enclosed construction coupled with dynamic back wash design provides contamination free separation. Bulletin 431.
177c *R. P. Adams Co.

Filters, Industrial.....are ideal for the filtration of process liquid & gases as well as polishing industrial water & waste. Complete details in Bul. 651.
177d *R. P. Adams Co.

Filters, Pilot Plant.....are available as self contained filter packages including pre-coat equipment. Additional information in Bulletin 610.
177f *R. P. Adams Co.

Filters, Porous.....Made of stainless steel, porous filters claim high flow rates at low pressure drops. Release M-212A gives full specifications on manufacturer's line.
208A Micro Metallic

Floats.....A complete line in a wide range of sizes, shapes, spud connections, in copper, brass, monel, stainless, aluminum, steel & nickel. Bulletin.
BL223 *Chicago Float Works

Jar Rolling Machine.....are available to handle single or parallel rows of jars, & in double or triple tiers for processing as many jars as required. Catalog 79.
R210 *Abbe Engineering Co.

Micronizers.....grind & classify in one operation in a single chamber & provide fines in range from ½ to 44 microns. Eight models are available. Bul. No. 091.
L20 *Sturtevant Mill Co.

Mills, Ball.....are noted for high tonnage & low cost processing of phosphate rock & other agricultural chemicals. Further details are now available.
81a *Kennedy Van Saun

Mills, Roller.....are engineered for automatic, uniform fine grinding. Feature whizzer air separation, pneumatic feed control and are self-lubricating. Catalog No. 79.
102 *Combustion Engr., Raymond Div.

Mills, Roller.....with exclusive gearless & spur gear drives. Quality fine grinding . . . 20 mesh to 400 mesh . . . micron sizes on some materials. Catalog.
43 *William Patent Crusher

Mixer.....Turbulizer features heavy steel shell with machined interior & heavy duty outboard bearings. Solves many dispersion problems in chem. & food industries. Facts.
151 *The Strong Scott Mfg. Co.

Mixers.....New Catalog "D" gives technical data & specifications of the complete line of Mass & Paste mixers & Ribbon mixers with illustrations of equipment, etc.
208B Paul O. Abbe, Inc.

* From advertisement, this issue

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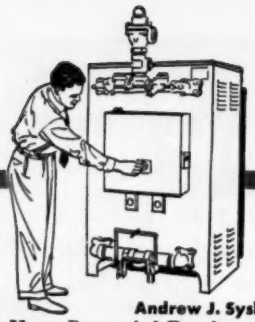

Andrew J. Syska,
Hayes Research & Development Engineer Reports . . .

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LITERATURE . . .

Mixing & Grinding Equipment..... Complete information on dry crushing and pulverizing mills, hopper mills, high speed dissolvers or dispersers, & mixers of all types.
208 *Charles Ross & Son Co.

Precipitators.....“SF” electric precipitators offer high-efficiency operation, fewer shutdowns and process interruptions. Descriptive literature offered.
173 *The Buell Engr. Co.

Process Equipment.....A new 32-page catalog illustrating & describing colloidal mills, homogenizers, pigment mills & related equipment for various industries is offered.
210A Tri-Homo Corp.

RDC Columns.....in successful operation for manufacturers of chemicals, petro-chemicals, petroleum & foods. Bulletin #T-1159.
138 *General American Transportation Corporation

Ventilators.....Vano Ventilators are portable & easily adaptable to practically any “fresh-air” requirements in industry. Facts available on request.
T198 *Coppus Engr. Co.

Pumps, Fans, Compressors

Exhauster.....Cast Iron Exhausters are built to withstand extreme corrosive conditions in the chemical process industries. Full information is available.
29a *Buffalo Forge Co.

Fan.....Resin-Bonded Fiber Glass Fume Fans are resistant to such chemical corrosives as acids, salts, gases, organic materials & others. Bulletin FI-511.
29b *Buffalo Forge Co.

Pump.....Booklet contains facts you should know about a revolutionary answer to your corrosive-pumping problems. It's all about Goulds-Pfaudler glassed pump.
100 *Goulds Pumps, Inc.

Pump, Centrifugal.....The CENTRI-CHEM handles most chemicals, including slurries with particle size up to $\frac{1}{8}$ of an inch, as well as troublesome sticky fluids. Lit.
207c *Eco Engineering Co.

Pump, Gear.....The GEARCHEM pump for temperatures up to 400 F. and viscosities to 10,000 SSU. Capacities to 10 gpm. Pressures to 100 psi. Literature offered.
207a *Eco Engineering Co.

Pump, Rotary.....The self-priming ALL-CHEM displacement pump with twin opposed oscillating impellers is designed for severe corrosive service.
207b *Eco Engineering Co.

Pump, Screw.....External Gear and Bearing Screw Pump can be furnished with heating or cooling jackets, with hopper type body, & in any metal. Detailed Bul. 206.
170 *Warren Pumps, Inc.

Pumps.....Types Q and SQ can handle considerable volumes of air or gas mixed with liquid. Facts about these pumps & the advantages of the open impeller design.
147 *The Labour Co.

* From advertisement, this issue

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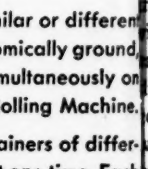

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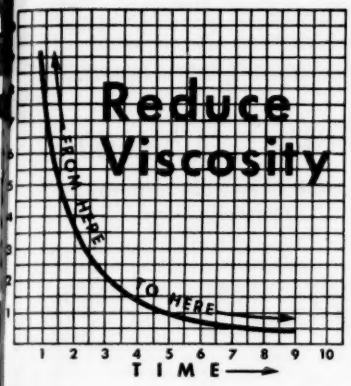

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LITERATURE . . .

Pumps.....Heavy-Duty type made of stainless steel, monel, mild steel & other alloys can be operated up to 100% rated speed on thin liquids. Catalog MC.
B200 *Viking Pump Co.

Pumps, Condensation.....Bulletin CP-600 explains and illustrates six basic condensation pumps. Includes features, specifications, engineering data, drawings, operations.
211A American Air Filter Co.

Pumps, Conveyors, Compressors..... 12-page Bulletin G-3C lists complete product line. Operating principles are explained, and photographs typical installations.
211B Fuller Co.

Pumps, Leakproof.....Bulletin 1050-4 gives design features and model specifications for leakproof pumping of corrosive, toxic, explosive and other problem fluids.
211C Chempump Div., Fostoria

Pumps, Proportioning.....Feed precisely metered fluids or slurries in all ratios with controlled process variables. Bulletin covers 100 series and 200 series.
R192 *American Meter Co.

Services & Miscellaneous

Application Research.....Engineering staff research problems of every description from the design stage right through to how equip. performs years after installation.
92 *Lukens Steel Co.

Corrosion-Proof Installations.....are covered in Bul. CC-3. Includes; pickling, plating, chemical processing & storage tanks of all kinds, industrial floors, etc.
L174 *Atlas Mineral Products

Engineering & Construction.....The complete story of coordinated engineering, procurement, & construction services in "Planning the New Plant for Profits".
153 *The M. W. Kellogg Co.

Engineering Service.....Four-Fold Engr. Service offers comprehensive survey of your facilities, specific proposal, installation supervision & periodic inspection. Details.
51b *Becco Chemical Div., FMC.

Equipment.....Catalog A-9 describes the complete line of blinds, spacer rings, temporary and line strainers, pivot rings, etc. that are now available.
C223 *The Mack Iron Works Co.

Slide Rule.....Lists 22 metals and materials and their degree of resistance to 247 corrosive agents. Slide Rules are available on request.
71b *Hoke, Inc.

Fire Safeguards.....28-page catalog describes fire-fighting equipment with information on sprinkler, 66², smoke detection, dry chemicals, and foam systems.
211D The Fyr-Fyter Co.

Fused Quartz Ware.....32-page catalog describes products made of pure fused quartz and silica. Complete specifications on laboratory and industrial ware are given.
211E Thermal American Fused Quartz

* From advertisement, this issue

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1 Monel Vertical 5000 Gal. Tank; 10′ Dia. x 8′ H. with coils and Agitator.
Struthers Wells 2000 Gal. Stainless Steel Reactor.
Mojonnier Stainless Vacuum Pans 3′x10′; 6′x12′.
Harris Stainless Coil Heated Vac. Pan; 6′ Diameter.
Lancaster Stainless Lined Rot. Jcktd. Reactor; 50″ x 17′ 4″.
Buffalo Cast Lead Evaporators; 5′ and 6′ Dia. & accessories.
Nickel Clad Reactors; 7′x11′6″ Manhole; Jacketed and Agitated.
Patterson 1000 Gal. Closed Jktd. Steel Mixing Kettle; 20 HP.
Three Stage Continuous Agitated Reactor; 3 Vessels 4′x20′.
Type 316 Stainless Separator Tanks; 42″ x10′; Dished Heads.

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Internationally known British merchant house specializing chemicals/plastics field seeks European agency arrangements with United States suppliers would also consider manufacturing proved products in Europe under license or partnership in similar venture advertiser's representative will be visiting America in February/March 1960 and suggests any interested persons contact BO-3498, Chemical Engineering. All replies treated in strict confidence.

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3—New 25 Ton, 2 GE i Whitecomb.
3—23 Ton, 2-45 Ton Used Gen. Elec.
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1—25 Ton, Industrial 60′ Boom Loco. Crane

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2—6′ x 36″ Hardinge Ball Mills
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2—5′ x 8′ Kennedy Van-Saun air swept Ball Tube Mills with Motors & Elec. Eye
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No. 1 Sturtevant Rotary Fine Reduction
2′ Symons Standard Cone Crusher
36″ x 20′ Ruggles Coles Class XF-1 Rotary Dryer #705—24 Link Belt Roto Louver Dryer
54″ x 35′ Louisville Monel Steam Tube Dryer
4′ x 20′ Rotary Dryer
5′ x 30′ Ruggles Coles Class XA-8 Rotary Dryer
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4—Sharples C20 Super D-Hydrators, 316 S.S.
1—Sharple PN14 Super-D-Canters, 316 S.S.
1—AT&M 26" sus. Cent., perf. bskt., 316 S.S.
1—Oliver 8' x 8' Precoat rubber covered Rotary Vacuum Filter.
4—Sperry 36" plate & frame Filters, rubber covered, cast iron, and wood.
5—8' dia. x 24' rubber lined Crystallizers.

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2—Abbe 5' x 16' brick lined Mills.
2—30' dia. Stainless Steel Micronizers complete with Hoppers, Conveyors, etc.

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1—Traylor 11' x 155' Rotary Kiln, 7/8" shell.
1—Renn. 6' x 60' Rotary Kiln, 5/8" shell.

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5—8500 gal. Vertical Storage 8'6" x 16' x 8' cone.
1—13,000 gal. Horizontal Storage 8' x 35'.

STEEL TANKS

6—2000 to 5200 gal. with Turbo Agitators.
14—Storage Tanks: 3800; 6000; 9000; 10,000; 15,000; 47,000 gals.

MISCELLANEOUS

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54—Storage Tanks, 1000 to 80,000 barrels.
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Phone NORCO 6571

CIRCLE I READER SERVICE CARD

BUY BRILL

REACTORS—EVAPS—CONDS—TANKS

2—Pfaudler 50 gal. 316 S.S. jacketed, agitated Reactors.
1—Condenser Service 650 gal. 304 S.S. closed, kettle, 5' x 4', with 100 sq. ft. bayonet heater.
1—1400 gal. Blaw-Knox, steel jacketed, agitated Reactor.
2—2000 gal. Struthers Wells 316 S.S. jacketed, agtd. Reactors.
2—3200 gal. 304 S.S., jacketed, agitated Kettles.
1—550 sq. ft. Buflovak, monel single effect Evaporator.
1—Baker Perkins 700 gal. jacketed, agitated Dissolver.
1—7500 gal. 316 S.S. Vert. Storage Tank, 7' x 25', 50 psi.
1—750 gal. nickel clad Mixing Tank, 125# nickel coils.
1—4000 gal. Haveg Vert. Tank 8' x 12'.
1—1500 gal. Stainless Pressure Tank, 5' x 10', 90#.
1—12,000 gal. horiz. steel Pressure Tank, 7'6" x 36', 200 psi.
1—17,850 gal. 304 S.S. Storage Tank, 9' x 36'.
6—Stainless Heat Exchangers; 1220, 786, 536, 396, 315, 250 sq. ft.
1—24" dia. x 25', 304 S.S. Bubble Cap Column.
1—30" dia. x 20', 304 S.S. Bubble Cap Column.

CENTRIFUGES

1—Sharples C-27 Super-D-Hydrator, 316 S.S.
1—Bird 18" x 28", 316 S.S. Solid Bowl, Continuous.
1—Bird 18" x 28" steel, Solid Bowl, NEW, Continuous.
1—Bird 36" x 50", 347 S.S. Solid Bowl, Continuous.
2—Sharples PY14, PN14, Super-D-Canters, 316 S.S.
1—Tolhurst 32" Suspended, 316 S.S., imperforate basket.
2—AT&M 48" Suspended, 316 S.S. basket.
2—Sharples #16, 304 S.S., 3 HP motor.

MIXERS

1—#12 Sturtevant 304 S.S. Rotary Mixer, 450 cu. ft.
1—Baker Perkins #16TRM, 150 gal. jktd., Vac. 60 HP.
5—Day "Cincinnatus" double arm, 250 and 100 gal.
1—1500# Powder Mixer, 7½ HP XP Motor.
2—Steel, jktd. Power Mixers, 225 and 350 cu. ft.
1—#0 Simpson Intensive Mixer.

DRYERS

1—Louisville 54" x 35', Monel Rotary Steam Tube Dryer.
3—Buflovak Vacuum Shelf, 20-60" x 80" shelves.
1—Devine Vacuum Shelf with 19—59" x 78" shelves.
1—Devine Vacuum Shelf with 1C—40" x 43" shelves.
2—Buflovak 42" x 120", atmospheric, double drum.
2—Devine 5' x 12', 4' x 9', single drum, atmospheric.
1—Baker Perkins 5'6" x 6' Rotary Vacuum Dryer.
1—Buflovak 3' x 20' Rotary Vacuum Dryer, 316 S.S. Unused.
2—Louisville Rotary Steam Tube 6' x 25', 6' x 50'.
9—Rotary Dryers, 34" x 30', 4' x 40', 6' x 50', 6' x 60', 7' x 80', 8' x 87'.
2—Louisville 8' x 50' Stainless Steel lined Rotary Dryers.
1—Traylor 30" x 18' Stainless Steel Rotary Dryer.
2—Link Belt, 7'5" x 25", 6'4" x 24', S.S. Louvre Dryers.

FILTERS

1—Oliver 6' dia. Horizontal Filter, 316 S.S.
1—Oliver 3' x 6' Steel Rotary Vac. Precoat Filter.
1—Niagara #370-38 Filter, 370 sq. ft, 304 S.S.
2—#49 Vallez Rotating Pressure Filters, 738 sq. ft.
1—Oliver 5'3" x 8' Steel Rotary Vacuum, vaporite housing.
1—Sparkler 33S28 Filter, 150 sq. ft., 304 S.S.
2—Sparkler 18D8 Filter, 12.3 sq. ft., 304 S.S.
1—Feinc 5' x 6' Stainless Steel Rotary Vacuum Filter.
2—#10 Sweetland Filters, 27 leaves, 4" centers, 250 sq. ft.

MISCELLANEOUS

1—Hpm 88 ton horizontal Steeping Press.
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2—Sweetland #2 Filters, 12 leaves on 3" centers and 18 leaves on 2" centers
1—Braun Stainless Shell & Tube Heat Exchanger. ⅝" tubes. 175 sq ft area
2—Standard Steel Rotary Dryers, comp. 1—70" x 60' and 1—5' x 47'
2—Louisville 6' x 50' Steam Tube Dryers, ⅜" shell complete
1—Denver Engineering 5' x 16' Buhrstone Lined Ball Mill, w/scoop feed
1—Readco S.S. 20 gal. working cap. Bbl Sigma Mixer, jcktd. Vac cover

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Autoclave: 50 gal. Struthers Wells, st. st.
Centrifugal: Tolhurst 20" st. steel (New).
Dewaterers: Davenport 3A, bronze hd. 3 hp.
Disintegrator: Rietz RD18-P, 75 hp.
Dryers: Devine 2 x 4' vac. drum, st. steel.
Dryer: Bowen lab. spray st. steel.
Dryer: Louisville 30' steam tube.
Evaporator: Buflovak st. st. 94 sq. ft.
Filter: Oliver precoat 12x2" st. steel.
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Kettles: st. steel, with and without ag. Dopp 150 gal. dbl. act. agitator.
Mills: Mikro, ISH, 5 hp.
Fitz Comminuting model D, models D and M.
Colloid, 3, 5, 20, 25 hp.
Cog stain. steel, 10 hp.
Mixers: Dbl. and Sgl. arms sigma blade.
Dry Powder, various sizes.
W. & P. size 14, 50 gal. jktd.
Mix-Muller Simpson 18" lab., 39½" Porto.
Pumps: Rotary, gear, centrif., vacuum.
Screen: Rotex model 41 st. steel.
Still: Double effect st. st. 11.83 gal.
Tablet Press: Stokes DD2, 23 station.
Truck Tanks: Stain. steel 1200, 1600 gal.
Vacuum Pans: 42" and 72" stain. steel.

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FOR SALE

Tolhurst type 316 S/S Centrifugal, hyd. drive.
Rietz RD 18-P Disintegrator 75 H.P.
Stokes 4' x 9' atmospheric double drum Dryer.
Prater size 009 Pulverizer with 125 HP TEFC mtr.
Sedbury size 4 WDC 20 Pulverizer with 7½ HP mtr.
Monjonnier S/S Vacuum Pan, 153 sq. ft. htg., surface complete.
Baker Perkins size 17 DAM 200 gal. unidor Mixer, 80 HP, cored blades, steam jktd., vac. cover.
Rotex model 41, 40 x 120" two deck Sifter.
Selectro 18" x 4' and 2' x 4' one and two deck S/S Sifters.

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CIRCLE L ON READER SERVICE CARD

VALUES GALORE—BUY NOW!

Stainless Steel Condenser 54 sq. ft.
Fletcher 30" Type 316 S.S. Sus. Style Centrifuge.
Day #31 Roball Sifter, S.S. 20" x 48"—M.D.
Cylindrical Spiral Mixer 3' x 12' Jack.
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Mixers, Kettles, Tanks, Conveyors, etc.
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2—5' x 8' BALL TUBE MILLS

2—5' x 8' Kennedy Van Saun Air Swept Ball Tube Mills with disc feeders, fans, piping, all motors and electric eye mill level controls.

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COMPRESSORS

World's Best Rebuilts

74 CFM 1500 PSI 6¼-3¾-1⅝x7 CP. TCB3
100 CFM 150 PSI 6x7 Ing. ES-I
104 CFM 2500 PSI 6¾-4¼-1 11/16x9 IR-ES3
110 CFM 3000 PSI Ing. GC 50BW
138 CFM 100 PSI 7x7 Ing. Rand ESI
162 CFM Vac. 10x5 IR-Vertical
238 CFM 100 PSI 9x9 ING. ES Worth HB
311 CFM 1500 PSI 10½-7½-3⅛x13 IR-ES3
465 CFM 100 PSI 12x11-IR-ES-I-Chic. P.T.
502 CFM 125 PSI 12x13 Chic. T
686 CFM 100 PSI 14x13 Ing. ES
823 CFM Vac. 18x7 Ing. ES-I
1055 CFM 110 PSI 18-11x12 I.R.XRE
2360 CFM 50 PSI 19-19x14
3135 CFM Vac 31x13 Ing. ES Worth HB
3078 CFM 110 PSI 30-18x21 Ing. PRE2
500 HP Syn 3-60-2300/4000

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ECH SPECIAL

Colton #5½ Preformer max. dia. of tablet 3", max. dia. of ceil. 2⅛" Cap. 50 Tablets per min. Stokes RB2 16 punch Rotary Tablet Mach. w/mtr.

YOU CAN BANK ON

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CIRCLE V ON READER SERVICE CARD

1—Blender — #12 Sturtevant —dustless—450 cu ft—SS—complete with drive—40 HP motor—and spare part inventors.

Nearly new condition.

3—Homogenizers — Tri-Homo —"16" Hi Torquie—SS-T-316 —with "V" Belt drive and 100 HP AC motors — explosion proof.

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MACHINECRAFT

S.S. Blender 100 cubic ft.
Blaw-Knox 2 gal S.S. Autoclave 5000 lbs.
50 gal S.S. Autoclave 2000 lbs. pressure
3½ gal S.S. Autoclave 2000 lbs. pressure
Vulcanizer 60" x 9' 125 lbs.
Sweetland #2 all stainless
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Proctor & Schwartz finned drum driers

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Special Offer

2—200 gals. S.S. Mixers, sigma cored blades, tilt type, powered by 1½ H.P. motor, complete with 75 H.P. XP motor. Cavagnaro original cost $52,000 each, priced reasonably low.

2—Printing machines, Lembo, R.B.F. 4 colors. 60" wide, complete with dryers, for plastics, coated fabrics, etc.

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ALDRICH HIGH PRESSURE WATER PUMPING SYSTEM

1200 p.s.i, 78' 36 Plate Fractionating Column with Accessories & Reboiler, Solvent Vapor Recovery System-Stainless, Tolhurst Centrifuges, Rotary Drum Dryer

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CENTRIFUGAL

Tolhurst 32" suspended type. Bottom Discharge. Imperforate basket and shaft, both of stainless steel. Also stainless pumps. Complete with seven and one half horse power motor, 900 & 1800 rpm. 220/440 volt and controls. Used—Excellent condition.

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8" NEW ALUMINUM PIPE

7500 Feet—8,741 O.D. x .150 Wall x 20' 0" 6061-T6 Specification ASTM-B-235-52T with Victaulic Adaptors each End (8⅝" O.D.). Phone, Write or Wire

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CIRCLE B ON READER SERVICE CARD

LIQUIDATING

AT ORANGE, TEXAS AND OTHER LOCATIONS

COLUMNS—STAINLESS STEEL

1—110" dia. Vulcan, 10 trays— bubble caps, T316 SS.
2—96" dia. Vulcan, 30 trays—bubble caps, T316 SS.
1—96" dia. Vulcan, 10 trays—bubble caps, T316 SS.
2—60" dia. Vulcan, 10 trays—bubble caps, T316 SS.
1—48" dia. Vulcan, 25 trays—bubble caps, T304 ELC SS, 100 PSI.
3—24" dia. Vulcan, 12 trays—bubble caps, T316 SS—VACUUM.
6—T316 SS Packed Columns: 42", 36", 30" dia.
5—Steel Packed Columns: 60", 48", 36", 30", 20".

COLUMNS—COPPER

5—Vulcan copper bubble—cap columns, VACUUM! 72" x 40 plate; 48" x 25 plate; 48" x 22 plate; 24" x 20 plate.

FILTERS—CENTRIFUGALS

1—Niagara #510-28, 510 sq. ft. vert. leaf, T316 SS.
1—Niagara #36H-110-3, 100 sq. ft., vert. leaf, T304 SS.
1—Alco 110 sq. ft., T316 vert. filter.
1—Sparkler #33-S-28, 151 sq. ft. horiz. plate, T304 SS.
1—Eimco 18" dia. x 24" face T304 SS rotary vacuum filter.
2—Oliver 5'3" dia. x 3' face rot. vac., pressure precoat, T316 SS.
1—Oliver 5'3" dia. x 8' face rot. vac., precoat, steel. UNUSED.
8—Sharples #AS-16V super cent. Inconel, Vapor-tite, 3 HP.
2—Sharples #16P, T304 SS pressure-tite centrifugals.
6—Sharples #16 super cent., T304 SS.
3—Sharples #C-20 Super-D-Hydrators, T316 SS.
2—Bird 18" x 28" horiz. cent., T304 SS or steel.
1—Bird 32" x 50" horiz. cent., T316 SS.
2—Sperry 30" P. & F. filter presses, 19-9 st. st. (NI-RESIST)

EXCHANGERS—CONDENSERS—COOLERS

1—2000 sq. ft., T316 SS vert. condenser.
1—1960 sq. ft., T316 SS horiz. ex., ASME.
12—800 sq. ft. T316 SS heat exchangers, removable bundle.
75—T316 tubular heat exchangers & condensers, 2000, 1450, 880, 800, 750, 600, 530, 427, 400, 300, 264, 250, 235, 200, 185, 165, 150, 125, 64, 50, 47, 30 sq. ft.
25—Copper & Cupro-Nickel heat exchangers & condensers, up to 1070 sq. ft.

STAINLESS STEEL TANKS

1—17,650 gal., horiz., T316 SS, 9' x 36', ¼" shell, ⅜" dished heads, 40# WP.
1—10,000 gal., horiz., T304 SS, 8' x 26', cone heads.
1—3700 gal., vert., T304 SS, 6' x 17', VACUUM, int. coils.
1—3400 gal., horiz., T304 SS, 6'6" x 16', ¼" shell, 7/16" dished heads
1—3300 gal., vert., T304, SS, 6' x 14'6", ⅜" shell, ⅜" heads, 70# WP.
1—2830 gal., horiz., T316 SS, 6' x 12', 5/16" shell & dished heads, VACUUM or 80# WP.
3—2750 gal. vert., T316 SS, 7' x 8' dished heads, 50# WP, 75 sq. ft. coil.
6—2600 gal. vert., T316 SS, 7' x 8', flat bottom, 19# WP, 5 HP agit.
1—2500 gal. vert., T316 SS, 7' x 7', ¼" shell, 5/16" dished heads, 70# WP.
6—2250 gal., vert., T316 SS, 7' x 6'3", dished heads, 70# WP, 5 HP agit.
1—1900 gal. vert., T316 SS, 6' x 8', ⅜" shell & dished heads, VAC. or 100# WP.
12—1750 gal. vert. hoppers, T304 SS, double cone bottom.
4—1200 gal. vert., T316 SS, 5' x 7', cone bottom, VACUUM.
100—Tanks & vessels, 100 to 1000 gal., all types, etc.

BEST BUYS

12—4500 gal. nickel-clad tanks, 8' dia. x 11' high, cone bottom, 125# WP.
1—Struthers-Wells 630 sq. ft. T316 SS evaporator.
3—18,000 gal. Aluminum cone-bottom tanks, 12' dia. x 31' OAH.
1—1960 sq. ft. T316 SS horiz. exchanger, ASME 75# WP.
1—Link-Belt #604-18 roto-louvre dryer, cyclone, fan, etc.
3—Worthington 160 ton steam-jet vacuum refrig. units.
2—Buffalo T316 SS blowers, 2330 cfm, 60 HP TEFC.
2—1800 cu. ft. Read T304 SS weigh hoppers, with scales, T304 SS screw conveyor, bucket elevators, AJAX "Lo-veyor" shaker conveyors.
1—Patterson 6' x 8' porox-lined pebble mill, 50 HP gearhead.
1—Bartlett & Snow 3' x 15' everdur rotary dryer.

STAINLESS REACTORS—KETTLES

1—3500 gal. T316 SS, Struthers-Wells, jkt., int. coils, 40/20 HP paddle agit.
1—2200 gal. T316 SS, Comb. Eng. jkt. Vccuum int., 7½ HP paddle agit.
1—900 gal. T304 SS, PERRY PRODUCTS, 90# jkt., Vacuum int.
2—750 gal. T304 SS, GRAVER, 30# jkt., 30# int., ASME, 10 HP turbine agit.
1—600 gal., BARTLETT & SNOW, 6' dia. crystallizer, jkt., HP anchor agit.
6—465 gal., T304L SS, DOWNINGTOWN, 165# jkt., 150# int. WP.
2—125 gal., T304 SS, 30# jkt., 30# int. WP.

STEEL & GLASS LINED REACTORS

2—1800 gal. steel, 200# jkt., 6' x 8'8", paddle agit.
1—1000 gal. Dopp, Cast Iron, 125# jkt., 25 HP anchor agit.
2—1000 gal. Patterson steel dissolvers 15# jkt., 20 HP turbine agit.
2—750 gal. Pfaudler glass, jkt., 3-blade agit.
1—500 gal., Pfaudler glass, 90# jkt., ASME, 3-blade st. st. agit.
2—400 gal., Glascote steel, 75# jkt., ASME, 3-blade agit.
1—300 gal. Glascote glass, 75# jkt, ASME, 3-blade agit.

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Fletcher 30" Susp. S.S. 10/5 H.P. Centrif.
Fletcher 40" Susp. Steel Centrifugal
Oliver 5'3"x3' Stainless Precoat Filters
Sweetland #10 Filter Press
Nooter 750 gal. Steel Reactor 300 PSI
Link Belt 502-16 Roto-Louvre Dryer
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Vulcan 9'x100' Rotary Kiln
Standard 5'x45' Rotary Dryer
Mosser 4'x47' Rotary Dryers
Louisville 6'x50'; 6'x25' Steam Tube Dryer
P&S Conveyor Dryers 3'; 8'; 10' S.S. Belts.
F. J. Stokes #28 Dryer
Aluminum Tanks 34,500; 5800; 1300 gal.
Stainless Tanks 6800; 2300; 500; 200 gal.
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11–BAKER PERKINS size 16, type UUEM, 150 gal. jacketed double arm dispersion type MIXER, Complete with Compression cover and 100 HP Motor

2–STURTEVANT #7 SS Dust Type ROTARY BATCH BLENDERS, NEW

1–EIMCO TYPE 316, Stainless Steel, ROTARY VACUUM DRUM FILTER, 3' x 1' complete

1–OLIVER SS Rotary Pressure PRE-COAT FILTER 5'3" x 8'

4–TOLHURST 40" Center Slung RUBBER COVERED CENTRIFUGES with perforated baskets and motors

5–PFAUDLER Series XL 1000 gal. glass lined JACKETED REACTORS complete with drives and anchor type agitators

1–PFAUDLER Series R, 300 gal. glass lined JACKETED REACTOR, impeller type agitator and drive, 125# PSI internal, 85# psi jacket

3–STRUTHERS WELLS type 316 SS JACKETED REACTORS, 2000 gal, complete, agitators and drives 40# int. pressure

1–17,850 gal. type 304 SS STORAGE TANK, 9' x 36', ⅜" material throughout

2–LOUISVILLE 6' x 50' ROTARY STEAM TUBE DRYERS Complete

15–DAVIS Eng. SS Heat Exchangers, 145 sq. ft., NEW

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1—Downington type 316 SS Heat Exchanger 750 sq. ft.
1—Stokes SS granulating Mixer model 21 J.
1—Pfaudler Series EL, glass lined jacketed Reactor, 300 gal. complete, anchor type agitator and drive
15—Robinson type 304 SS horizontal Blenders 255 cu. ft.

AUTOCLAVES, KETTLES AND REACTORS

1—Aluminum 16000 gal. horiz. storage Tank
5—Aluminum vertical storage tanks 1300 gal. each
1—4000 gal. vertical stainless steel storage tank
1—Type 316 SS 2000 gal. horizontal tank
10—Vertical stainless steel storage tanks, 750 and 500 gal.
1—Pfaudler 200 gal. glass lined jacketed reactor, complete with impeller type agitator and drive.
5—Pfaudler 200 gal. glass lined jacketed reactors, complete with anchor type agitators and drives
1—Pfaudler 100 gal. glass lined jacketed reactor, complete with anchor type agitator and drive
1—Pfaudler 50 gal. glass lined jacketed reactor, complete with anchor type agitator and drive
1—Pfaudler 100 gal. glass lined vacuum receiver
1—Steel and Alloy Tank Co. 100 gal. type 347 SS pressure tank, 250 psi jacket
1—Blaw-Knox 400 gal. steel jacketed autoclave, 570# internal pressure, 85# jacket
1—Blaw-Knox 45 gal. jacketed autoclave, 1500# pressure
1—Patterson-Kelley 6000 gal. steel jacketed kettle
2—Steel vertical jacketed reactors, 5000 gal. each
1—Haveg 300 gal. tank complete with agitator and drive

DRYERS

1—Traylor 11' x 155' rotary Kiln complete
1—Link Belt steel roto louver dryer, Model 1003-30
3—Link Belt steel roto louver dryers, Model 207-10, 310-16, 604-20
1—Stokes Model 59DS steel rotary vacuum dryer, 5' x 30'
2—Louisville rotary dryers, 8' x 50', SS
1—Louisville rotary steam tube Dryer 8' x 45'
1—Louisville rotary dryer, 38" x 40', Type L
1—Traylor 4' x 40' rotary dryer
1—Rotary dryer 6' x 36'
2—Stokes Model 138J-20 single door vacuum shelf dryer, 20 shelves, complete
1—Western Precipitation Corp. SS pilot spray dryer, Type N-2
4—Gordon single truck tray dryer

1—Edgemoor type 316 SS 750 gal. jacketed Reactor
2—Swenson type 316 SS vacuum Crystallizers 3'6" x 12', 2' x 12' complete
5—Nash Hi Tor vacuum Pumps model MD-2 with ½ HP motors NEW
1—Buflovak SS jacketed rotary vacuum Dryer 3' x 15'

FILTERS

3—Dorrco ruber covered filters, 6' x 2'
1—Sweetland #3 stainless steel filter
12—Sweetland #12 filters with 72 SS leaves
1—Niagara SS filter, Model 510-28
1—Oliver horizontal filter, 3'
10—Shriver plate and frame filter presses, 12" to 42"
1—Shriver aluminum 30" x 30" P&F filter press, 30 chambers
1—Shriver C. I. plate and frame filter press, 36" x 36", closed delivery, 4 eye, 60 chambers

CENTRIFUGES

1—Tolhurst SS 20" suspended type centrifuge with perforated basket, complete with plow and motor
1—AT&M 26" suspended type centrifuge with SS perforated basket, complete with plow and motor
1—AT&M 48" SS suspended type centrifuge, complete with plow, motor and imperforated basket
1—Bird type 316 SS centrifuge, 32" x 50"
2—Fletcher 40" center slung rubber covered centrifuges with perforated baskets and motors
1—AT&M 40" SS suspended type centrifuge complete with motor, perforated basket and plow

MIXERS

1—Baker Perkins size 16 type TRM 150 gal. jacketed double arm Sigma Blade Mixer with vacuum cover
3—Robinson type 316 SS sigma blade jacketed heavy duty mixers, 400 gal.
1—12' x 4' pug mixer, type 316 SS
1—Patterson type 347 SS jacketed vacuum sigma kneader master, 500 gal.
1—Baker Perkins size 20 2000 gal. double arm jacketed vacuum mixers with double NABEN blades
1—Entoleter Impact Mill type PPM-27

MISCELLANEOUS

1—Cleaver Brooks 500 HP package steam generator, 200#
1—York Shipley 175 HP package steam generator, 135# psi
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1—Badger type 316 SS bubble cap column, 36" dia. with 8 trays
1—Vulcan SS bubble cap column, 4' x 28 plates
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1—Ross 6" x 14", 3 roll paint mill, complete
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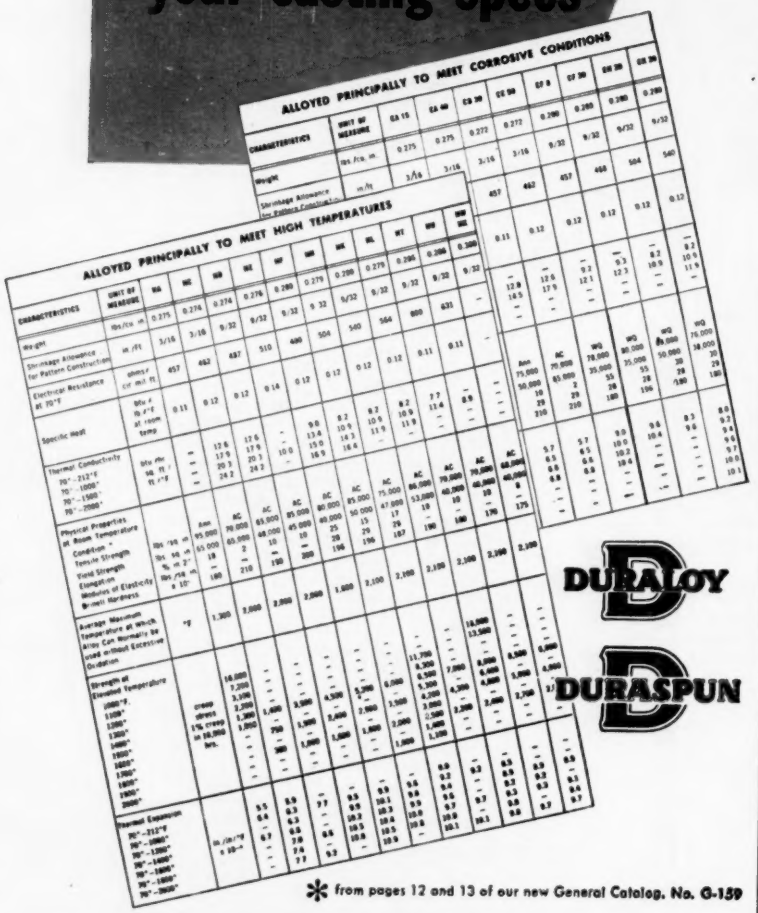

ALLOYED PRINCIPALLY TO MEET CORROSIVE CONDITIONS

CHARACTERISTICS	UNIT OF MEASURE	CA 15	CA 40	CA 28	CE 30	CF 8	CF 20	CE 20	CH 20
Weight	lbs./cu. in.	0.275	0.275	0.272	0.272	0.280	0.280	0.280	0.280
Shrinkage Allowance for Pattern Construction	in./ft.	3/16	3/16	3/16	3/16	5/32	5/32	5/32	5/32
Electrical Resistance at 70°F	ohms/cir. mil ft.	457	462	457	462	457	468	504	540
Specific Heat	Btu/lb./°F at room temp.	0.11	0.12	0.12	0.12	0.11	0.12	0.12	0.12
Thermal Conductivity 70°–212°F 70°–1000° 70°–1500° 70°–2000°	Btu/hr./sq. ft./in./°F	—	—	12.6 17.9 20.3 24.2	12.8 16.5	—	—	—	—
Physical Properties at Room Temperature Condition Tensile Strength Yield Strength Elongation Modulus of Elasticity Brinell Hardness	lbs./sq. in. lbs./sq. in. at 2" % lbs./sq. in. x 10⁶	Ann. 95,000 65,000 18 — 180	AC 70,000 65,000 2 — 210	AC 65,000 46,000 10 — 195	AC 85,000 45,000 10 — 200	AC 80,000 40,000 25 20 196	AC 95,000 50,000 15 20 196	AC 75,000 47,000 17 29 187	AC 86,000 53,000 19 — 190	AC 70,000 40,000 35 — 160	AC 68,000 40,000 9 — 175
Average Maximum Temperature at Which Alloy Can Normally be Used without Excessive Oxidation	°F	1,300	2,000	2,000	2,000	1,800	2,100	2,100	2,150	2,100	2,100
Strength at Elevated Temperatures 1000°F. 1200° 1300° 1400° 1500° 1600° 1700° 1800° 1900° 2000°	creep stress 1% creep in 10,000 hrs.	16,000 7,200 3,250 2,200 1,300 700 — — — —	— — — — 3,900 1,900 — — — —	— — — — 4,500 2,600 1,500 — — —	— — — — 5,200 2,900 1,800 — — —	— — — — 6,000 3,500 2,000 — — —	— — — — 11,700 6,300 4,500 4,200 2,900 1,700 1,100	— — — — 7,200 4,200 2,900 — — —	— — — — 16,000 13,500 8,000 6,000 4,000 2,200 —	— — — — 8,500 5,500 2,700 — — —	— — — — 6,000 — — — — —
Thermal Expansion 70°–212°F 70°–400° 70°–1200° 70°–1400° 70°–1600° 70°–1800° 70°–2000°	in./in./°F x 10⁻⁶	5.5 6.4 6.7 — — — —	5.9 6.3 6.5 7.0 7.6 7.7 —	— 7.7 — 8.6 — 9.3 —	6.3 6.9 7.2 8.0 8.6 9.0 9.3	— — — — — — —	— — — — — — —	— — — — — — —	6.6 7.2 7.7 8.3 8.8 9.3 9.7	6.5 7.1 7.7 8.3 8.8 9.3 9.7	6.5 7.1 7.7 8.3 8.8 9.3 9.7

ALLOYED PRINCIPALLY TO MEET HIGH TEMPERATURES

CHARACTERISTICS	UNIT OF MEASURE	HA	HC	HD	HE	HF	HH	HK	HL	HT	HW	HX HH
Weight	lbs./cu. in.	0.275	0.274	0.274	0.278	0.280	0.279	0.288	0.278	0.295	0.298	0.300
Shrinkage Allowance for Pattern Construction	in./ft.	3/16	3/16	5/32	5/32	5/32	5/32	5/32	5/32	5/32	5/32	5/32
Electrical Resistance at 70°F	ohms/cir. mil ft.	457	462	487	510	490	504	540	564	800	631	—
Specific Heat	Btu/lb./°F at room temp.	0.13	0.12	0.12	0.14	0.12	0.12	0.12	0.12	0.11	0.11	—
Thermal Conductivity 70°–212°F 70°–1000° 70°–1500° 70°–2000°	Btu/hr./sq. ft./in./°F	—	—	12.6 17.9 20.3 24.2	— 10.0	9.0 13.6 15.0 16.9	8.2 10.5 14.2 16.6	AC 95,000 50,000 15 20 196	8.2 10.6 11.9	7.7 11.4	— 8.9	—
Physical Properties at Room Temperature Condition Tensile Strength Yield Strength Elongation Modulus of Elasticity Brinell Hardness	lbs./sq. in. lbs./sq. in. at 2" % lbs./sq. in. x 10⁶	Ann. 75,000 50,000 10 29 210	AC 75,000 65,000 2 29 200	WQ 78,000 35,000 55 28 180	WQ 80,000 35,000 55 28 196	WQ 85,000 50,000 35 28 180	WQ 75,000 38,000 35 29 170	—	—	—	—	—
Average Maximum Temperature at Which Alloy Can Normally be Used without Excessive Oxidation	°F	1,800	2,000	2,000	2,000	2,000	2,000	2,000	2,100	2,100	2,100	2,100
Strength at Elevated Temperatures 1000°F. 1200° 1300° 1400° 1500° 1600° 1700° 1800° 1900° 2000°	creep stress 1% creep in 10,000 hrs.	— — — — — — — — — —	— — — — — — — — — —	— — — — — — — — — —	— — — — — — — — — —	— — — — — — — — — —	— — — — — — — — — —	— — — — — — — — — —	— — — — — — — — — —	— — — — — — — — — —	— — — — — — — — — —	— — — — — — — — — —
Thermal Expansion 70°–212°F 70°–400° 70°–1200° 70°–1400° 70°–1600° 70°–1800° 70°–2000°	in./in./°F x 10⁻⁶	— — — — — — —	— — — — — — —	— — — — — — —	— — — — — — —	— — — — — — —	— — — — — — —	— — — — — — —	— — — — — — —	— — — — — — —	— — — — — — —	— — — — — — —

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Abbé Engineering Co. 210
Adams Co., R. P. 177
Allegheny Ludlum Steel Corp... 145
Allied Chemical Corp.
General Chemical Div. 59
Solvay Process Div. 79
Allis-Chalmers 191, 193, 195
Alloy Steel Products Co. 61
American Hard Rubber Co..... 163
American Meter Co.
Pump Div. 192
Ames Iron Works, Inc..... 45
Antara Chemicals Division
General Aniline & Film Corp. 75
Armstrong Machine Works..... 165
Atlas Mineral Products Co..... 174
Bailey Meter Co. 199
Becco Chemical Div., Food
Machinery & Chemical Corp.. 51
Belmont Packing & Rubber Co. 168
B-I-F Industries, Inc. 169
Bird Machine Co. 2
Bridgeport Brass Co. 166
Bristol Company 40
Brooks Rotameter Co. 202
Buell Engineering Co., Inc..... 173
Buffalo Forge Co. 29
Cambridge Wire Cloth Co..... 46
Camco Fittings, Inc. 221
Carrier Conveyor Corp..... 162
Celanese Corp. of America....12-13
Chemical & Power Products.... 186
Chemtrol 223
Chicago Bridge & Iron Co..... 142
Chicago Float Works..... 223
Cleveland Worm & Gear Co.... 161
Clow & Sons, Inc., James B..... 192
Combustion Engineering, Inc.
Raymond Division 102
Coppus Engineering Corp. 198
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Davenport Machine & Fndry. Co. 223

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Dow Corning Corp. 159
du Pont de Nemours & Co. (Inc.), E. I., Elastomers Dept. 89
Fabrics Div. 197
Duraloy Co. 220
Duriron Company, Inc., The... 149

Eclipse Fuel Engineering Co... 196
Eco Engineering Co. 207
Electric Machinery & Mfg. Co. 18-19
Emery Co., A. H. 187
Eimco Corporation....Second Cover

Falls Industries, Inc. 31
Fansteel Metallurgical Corp..... 42
Fischbein Co., Dave..... 204
Fisher Governor Co. 176
Flexitallic Gasket Co...Third Cover
Flexonics Corp. 91
Flour Corporation 87
Foxboro Corp. 37

Gardner-Denver Co. 94
General American Transportation Corp., Kanigen Div..... 201
Turbo Mixer Div..... 138
Gilbert & Barker Mfg. Co..... 27
Glas-Col Apparatus Co..... 30
Goodrich Industrial Products Co., B. F. (Koroseal)..... 1
Goulds Pumps Co. 100
Grinnel Co. 203
Gustin-Bacon Mfg. Co.....178, 179

Harshaw Chemical Co. 20
Hayes, Inc., C. I. 210
Haynes Stellite Co., Div. of Union Carbide Corp. 155
Hoke, Inc. 71
Hough Co., Frank G. 90
Hydromatics, Inc. 33-36

Illinois Water Treatment Co... 206
Ingersoll-Rand 22-23

Jeffrey Mfg. Co. 32
Johns-Manville (Celite) 224

Kellogg Co., M. W. 153
Kemp Mfg. Co., C. M..... 77
Kennedy Van Saun Mfg. & Engrg. Co. 81
LaBour Company 147
Lecco Machinery & Engrg. Co... 181
LimiTorque Corp. 24
Link-Belt Co. 21
Liquidometer Corp. 172
Lukens Steel Co. 92

Mack Iron Works 223
Markal Company 202
Marsh Instrument Co., Div. of Colorado Gas & Oil Corp..... 204
McGraw-Hill Book Co. 208
Metal Hydrides, Inc. 205
Metals & Controls, Div. of Texas Instruments, Inc. 4
Minneapolis-Honeywell 10-11

Nash Engineering Co..... 50
National Carbon Co., Div. of Union Carbide Corp..... 73
National Filter Media Corp..... 222
Norton Company 49

Pangborn Corporation 167
Parks-Cramer Co. 211
Pfaudler, Div. of Pfaudler Permutit, Inc. .....Fourth Cover
Phelps Dodge Copper Products Co. 16-17
Philadelphia Gear Corp. 24
Pittsburgh Corning Corp..... 182
Pittsburgh Des-Moines Steel Co. 8-9
Pittsburgh Lectrodryer, Div. McGraw Edison 194
Pulverizing Machinery Div., Metals Disintegrating Co..... 67

Raybestos-Manhattan, Inc. Manhattan Rubber Div. 28
Plastic Products Div. 180
Resistoflex Corp. 65
Robertshaw-Fulton Controls Co. Fulton Sylphon Division..... 171
Rockwell Co., W. S. 178
Ross & Son Co., Inc., Chas..... 208

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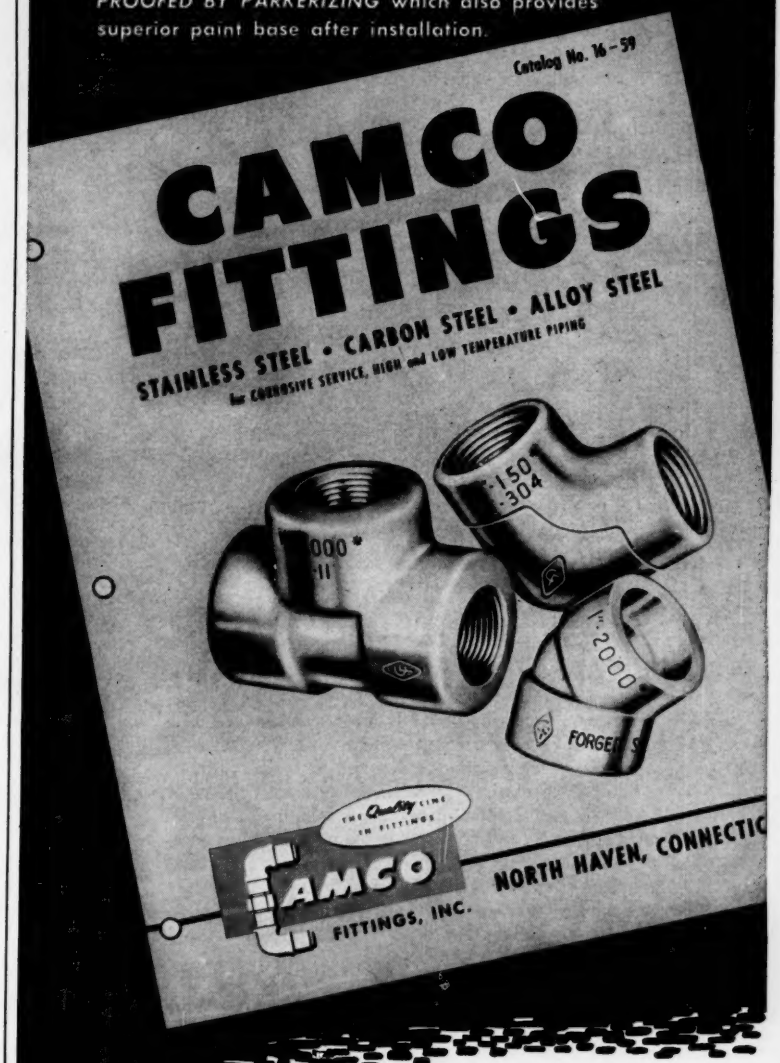

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Stone & Webster Engineering Corp. 93
Strahman Valves, Inc. 175
Strong-Scott Mfg. Co..... 151
Sturtevant Mill Co. 206
Struthers Wells Corp..... 83
Surface Combustion, Div. of Midland-Ross Corp. 190
Taylor Instrument Companies-14-15
Techno Corp. 198
Terry Steam Turbine Co. 48
Texas Gulf Sulphur Co. 41
Thermo Electric Co. 101
Tranter Mfg. Co., Platecoil Div...95
Traylor Engineering & Mfg. Div. of Fuller Co. 26
Trent Tube Co. 47
Union Asbestos & Rubber Co.... 54
Union Carbide Chemicals Co. Div. of Union Carbide Corp... 209
United Engineers & Constructors, Inc. 44
U. S. Rubber Co. 157
U. S. Stoneware Co. 52
Viking Pump Co. 200
Vilter Mfg. Co. 164
Vogt Machine Co., Henry..... 137
Warren Pumps, Inc. 170
Warrick Co., Charles F. 200
Waukesha Foundry Co. Casting Division 25
Western Supply Co. 103
Westinghouse Electric Corp. Sturtevant 39
Williams Patent Crusher & Pulverizer Co. 43
Yarnall-Waring Co. 175
York Corp. 69

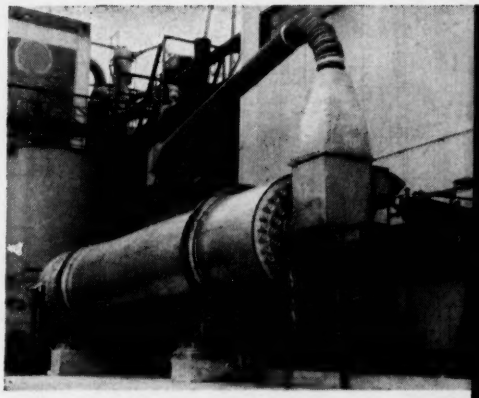
Professional Services 211

CLASSIFIED ADVERTISING
F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES 212, 213
SPECIAL SERVICES 214
EQUIPMENT (Used or Surplus New) For Sale 213-219

ADVERTISERS INDEX

Aaron Equipment Company..... 216
Alco Products Inc..... 213
Allied Chemical Corp., National Aniline Div.....212-213
American Air Compressor Corp..... 216
Beckman Instruments Inc..... 212
Brill Equipment Company..... 215
Brown Strauss Corporation..... 216
Chemstrand Corporation 216
Deming Machinery Company..... 216
Design & Consulting, Div. of Star Tank & Filter Corp..... 214
Equipment Clearing House, Inc..... 216
First Machinery Corporation..... 214
Gelb & Sons, R.....218-219
Heat & Power Company, Inc..... 218
Indiana-& Ohio Pipe Co..... 214
Lawler Company 216
Loeb Equipment Supply Co..... 216
Machinery & Equipment Co. Calif. 214-216-218
Machinery & Equipment Co., New Jersey 216
McKee Co., Arthur G..... 213
Perry Equipment Corporation..... 217
Process Equipment Sales Corp..... 216
Stanhope Inc. R. C.....214-216
Stein Equipment Company..... 216
Sussman Incorp., Louis..... 216
Thiokol Chemical Corp.....212-213
Union Standard Equipment Co..... 218



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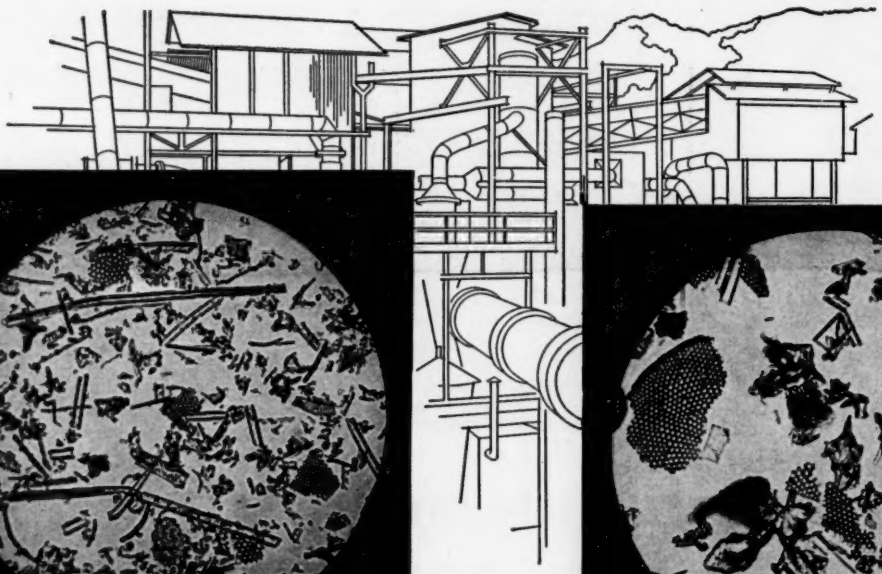

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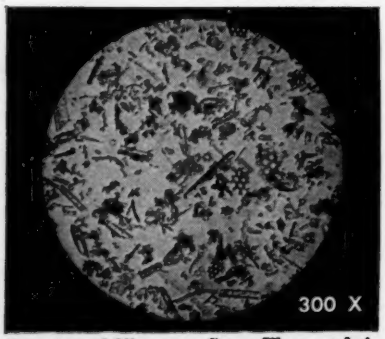

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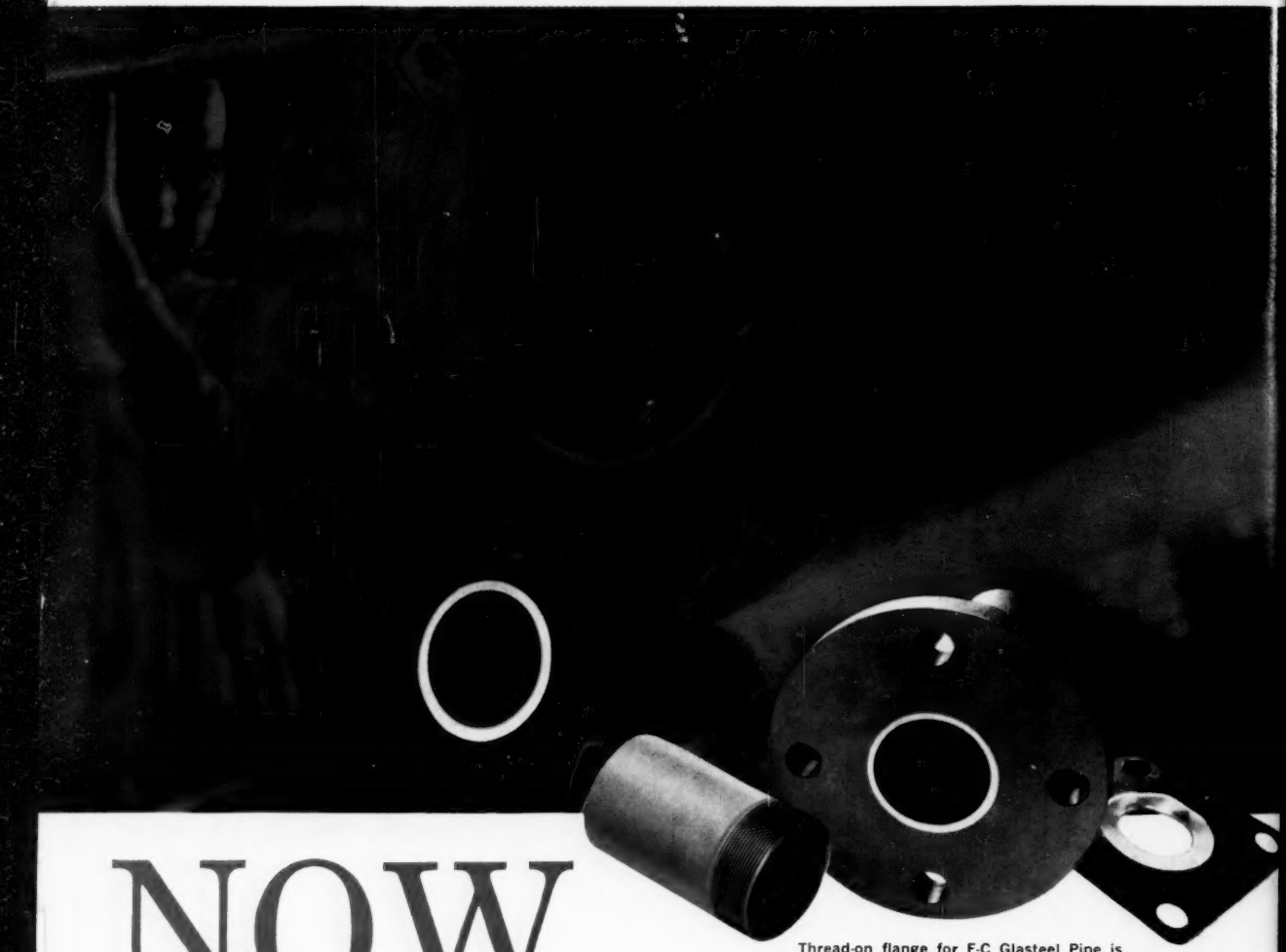

Thread-on flange for F-C Glasteel Pipe is ASA 150# Series. Gasket features corrosion-resistant Teflon envelope at product contact area.

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Glass lining for this new pipe is ⅛ inch thick, so you can expect substantially longer service life even with corrosive and/or abrasive fluids. Rated at 150 psi and available in 1½, 2 and 3 inch diameters, F-C pipe can be used with all acids (except HF) to 350° F. and with all mild alkalies at moderate temperatures.

Moreover, since glass is inert, you will also find this pipe useful for those products which must be kept free from contamination. And note, too, that because glass is smooth, there's little chance for build-up with sticky materials.

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As of now, you can get limited quantities from stock in lengths through 10 feet. For Bulletin No. 989 or for answers to specific questions on availability and delivery, please write to our Pfaudler Division, Dept. CEB-20, Rochester 3, N. Y.

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